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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.
FEBRUARY 16.

Scottish Branch (Falkirk Section):—Ordinary meeting at Falkirk. "Composition, Structure, and Properties of Various Cast Irons," Paper by R. S. M. Jeffrey.

Sheffield Branch:—Ordinary meeting at Sheffield. Short Papers and discussion on "Different Types of Moulding Machines."

Wales and Monmouth Branch:—Ordinary meeting at Cardiff. "Properties of Cast Iron," Paper by F. D. Corbin.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "The Story of Iron Throughout the Ages," Paper by E. Garside.

Newcastle and District Branch (Junior Section):—Visit to the Locomotive Works of Messrs. Armstrong, Whitworth & Company, Limited, Scotswood-on-Tyne.

FEBRUARY 22.

London Branch (Junior Section):—Ordinary meeting in London. "Manufacture of Malleable Castings," Paper by J. W. Gardom.

Trade Unions and the Worker.

A number of readers will have seen the comments made by Mr. Shinwell, M.P., who was Secretary for Mines in Mr. Ramsay MacDonald's Government. Mr. Shinwell very roundly declared that Trade Unions had done nothing for the worker, his aim being to drive home the necessity for political action.

While it is impossible not to see the point lying behind these remarks, the really astonishing thing is that their truth has not only not been seen before, but has not been appreciated by every worker with any claim to intelligence. Let us begin by admitting that the cost of any product consists in material, together with the labour spent on it, together with a margin for depreciation and profit. For the moment we can consider the labour to include overhead expenses, which are themselves very largely indirect labour charges, staff and administrative expenses, etc. Now charges for material are very largely charges for labour, because material of itself, and by itself, in its natural state, is worthless. It only takes on value when it is refined and distributed to the point where it can be used, and where demand for it exists. Distribution charges, again, are very largely labour charges. Even capital in the form of machines, warehouses, docks, harbours, railways, etc., requires to be kept in a state of renewal and repair, and material very soon rusts or rots without constant care and attention. In one form or another, then, the majority of costs entering into production are labour charges.

The next step in the argument is that there is an automatic check or balance between output and price. Suppose we consider for a moment a small community of people, say on a desert island, who naturally work to keep themselves alive and who naturally take advantage of the benefits of sub-division of labour and specialisation. If one group in one particular occupation insists on receiving more for its labour than it has been accustomed to, two things must happen to restore the balance: either the rest of the community must all work a bit harder to provide this increased demand, or, alternatively, the men who make the demand must work a bit harder themselves. If the island is large enough and prosperous enough and civilised enough to enjoy the conveniences of receiving wages in money, it is easy to lose sight of this connecton between output and service, and it may seem at first sight possible to get an increased wage without anybody doing any increased work. Clearly the rest of the community does not feel under any particular obligation to work harder to make somebody else better off. What usually happens, however, under these conditions is that one group seeks for an increased wage to come from some mysterious and quite illusory source, and does not perform any increased work. The automatic result of this procedure is that there is a slight increase all round in prices, with the result that the increased wages of the group just balance the increased prices. It is beyond the power of any trade union to upset the working of economic laws, and we suggest that in so far as trade unionism has failed it is because this connection between wages and output has been lost sight of.

If trade unions really want to help the workers the obvious thing to do is to put more into industry before they can take more from it. Increased output permits higher wages because it lowers prices, increases demand, and increases the standard of living, whereas increased wages with lower output raise prices, kill demand and lower the standard of living. When the workers realise that these elementary economic truths are inexorable we may really begin to get a move on. When that takes place we may see the rather ironic result that the employers will be appealing for the retention of trade unions as representative workers' organisations.

Opulence and Adequacy.

Dr. W. H. Hatfield, speaking at the annual dinner of the Sheffield Section of the Institute of British Foundrymen, in stressing the necessity of a continuous supply of well trained specialised scientists for aiding British industry to keep abreast of the time, expressed envy at the unique position of many American Universities, who apparently had "money to burn." We agree that the financial position of many of our educational establishments is desperate; we endorse the necessity of increased help from industry in general; yet we would deplore opulence as being conducive to waste, extravagance and laziness. We have seen certain sections of industry temporarily rich, and have seen the erection of magnificent offices and shops, associated with the installation of expensive machinery, and we have noted their inability to produce results as soon as the swing of the pendulum denotes a crisis. So, too, a university with "money to burn" may quite easily equip itself with plant destined to be obsolete in but a short space of time. Money cannot ensure that the occupant of a chair is enthusiastic, erudite and inventive, nor can it buy tradition, a factor of inestimable value in scholastic institutions. British universities have achieved an international reputation because of the outstanding genius of the professors of the various departments. We find that certain of the foreign professors are *so closely* connected with industry that their pronouncements are tinged with commercialism as to render their findings definitely suspect. Money rather than their profession is their *hut* in life. In metallurgy Britain has every reason to be proud of its past leaders of thought, and it has confidence that the present generation is adding lustre to the universities escutcheons. The maximum one can demand under present conditions, or even as they can be visualised in the future, is adequacy, and not opulence. Finally, it should be borne in mind that America is a continent, and their universities serve immense areas; whereas here, especially in the North of England, they exist at intervals of every fifty miles. We suggest that there are too many departments devoted to the teaching and study of each subject. We ask Dr. Hatfield, in all seriousness, whether, say, three metallurgical departments for the whole of Great Britain, adequately financed, should not amply meet the needs, peculiar though they may be, of the whole of this industry.

XUM

Institute of British Foundrymen.

SHEFFIELD BRANCH ANNUAL DINNER.

The annual dinner of the Sheffield and District Branch of the Institute of British Foundrymen was held at the King's Head Hotel, Sheffield, on February 8. Mr. J. T. Goodwin, M.B.E., M.I.Mech.E., the Branch-President, was in the chair, and there was a large gathering of members and guests. The function had been suspended for two years owing to the 1927 conference, which was held in Sheffield.

Sheffield and the Steel Industry.

The toast of "The City of Sheffield" was proposed by Mr. S. H. Russell, the President of the Institute. Sheffield, he said, was a city of intense interest to foundrymen. Whenever the name Sheffield was mentioned throughout the world one thought of steel, and one thought of Sheffield when steel was mentioned. The two were intimately linked together. It would be extremely presumptuous on his part to talk about steel castings, because he knew nothing about them, and had never attempted to make one, but he did feel that something should be said in Sheffield about what was happening in one of the other branches of the Institute. At Birmingham a few weeks ago there was a symposium on steel castings. There were only two steel founders present, and he had a very hot quarter of an hour. He asked if they had read any of the papers, and they said they had not. Those who had not read them would be interested to know that in the first place when the discussion was opened the representative of the Admiralty, more or less officially inspired, informed his audience that they wanted a better steel casting than they were getting. In the discussion it came out that steel castings were not all that was required. He hoped that in Sheffield the matter would be taken further. They would not agree with many of the conclusions reached; they were not all advantageous to the steel foundry trade. He thought it was suggested that a further debate should take place in the early autumn on somewhat similar lines, and that it should be held in Sheffield. There was another point, very much stressed, and that was the necessity for national co-operation as regarded improvement in quality, particularly of the small and thin steel castings. He was not a steel founder, but as President of the Institute he thought the attention of the Branches should be drawn to the position.

The LORD MAYOR (Alderman H. Bolton), replying to the toast, expressed his satisfaction that the Institute was growing in strength, and that the Sheffield Branch had scarcely any arrears of contributions.

"The Commerce of Sheffield" was proposed by Mr. G. L. Oxley, who said that Sheffield business men had experienced much difficulty in the last few years in trying to get sufficient orders to keep their plants running regularly, and many had not succeeded. He thought and hoped, however, that the slack times through which they were passing were fast drawing to a close. As to the future, the De-rating Bill, would, if properly applied, help the industries. After the next Parliamentary election he thought they would very likely have safeguarding of steel, which would go a long way to put the steel trade of Sheffield on a firm basis again. Having those two things in mind, and with trade slowly improving at the present time, provided they could keep clear of labour troubles in the form of strikes and lock-outs, he thought the outlook for the future was decidedly better.

The MASTER CUTLER (Mr. T. G. Sorby), responding to the toast, said that safeguarding was a very awkward subject. His recommendation was to expect no help from the Government or anybody else, but to do their best, and if they should receive any assistance they would reap still greater benefit by having concentrated on their job in advance. The Cutlers' Company had always before it the task of looking after the trade marks of the city, and seeing that goods were not sold improperly marked. They had during the last twelve months carried out two prosecutions, both successfully, showing that they wanted to maintain the quality of the goods. If they found instances of false marking in the future they would continue the same policy.

Co-operation in Industry.

"Guests and kindred associations" was proposed by Mr. Ambrose Firth, who expressed the view that if there were in the industry a little more of the spirit manifested on those occasions it would be to the advantage of the industry in general. Of late years matters had greatly improved. Twenty years or so ago many iron-founders and people in the steel industry generally, would not have allowed their competitors to go into their works and see what was being done. All secrets were jealously guarded, and everybody was kept at arm's length. To-day, he was pleased to say, things were very much changed, and they were now co-operating for the common good and for the ultimate benefit of all. He recently had the opportunity of visiting a number of foundries on the Continent, and he found that much the same spirit prevailed. Although actually those foundries were competing against his own firm, he was allowed to go round, talk things over, and they exchanged views which were to their mutual benefit. It was for that reason that they welcomed their guests so as to let them know something about their industry.

MR. C. L. MASON, M.C., M.I.Mech.E., in responding to the toast, said that to-day one had to belong to a large number of kindred associations in order to keep up with the march of progress. There was a time when a foundryman could start business in a very humble way with a couple of cart-loads of sand and a little scrap, and retire with a fortune in a few years' time. Unfortunately those days were now past. The modern foundryman had to be more than a foundryman. He had to be a bit of a metallurgist, a bit of a chemist, and a bit of a mechanical engineer, and there were times when, perhaps, he had to be a sort of civil engineer, for instance, when a customer complained that something delivered to him had slight traces of incipient porosity.

The BRANCH-PRESIDENT said the relationship with kindred institutions was at its highest in connection with the Institute. They stood second to none in their regard for other institutions, and the help they were prepared to give them if it was in their power to do so. The Institute welcomed them, and would support them for all they were worth. In doing so they heartily appreciated and applauded their efforts in other directions than technical—the enhancement of the domestic side.

The C.I.R.A. and the Universities.

MR. GOODWIN went on to refer to the British Cast Iron Research Association, which, he said, was on the verge of putting before this country and the world most important facts with regard to the future development of cast iron. A series of technical experiments and technical research had been carried on quietly without any fuss, and without any trouble, which had aroused the interest of the whole of the scientists in the metallurgical world. As vice-chairman of the C.I.R.A. he had the honour of attending a meeting in London on the previous Wednesday when certain fundamental principles of cast iron were discussed in their most highly technical aspect. Gathered at the table were scientists, all deeply interested in the data placed before them by the Association. The work being done was greatly appreciated by the scientists. Further steps were to be taken, and he hoped shortly to be able to state that news would be given to the world which would show that they were in advance of both the Continent and the world.

Wealthy American Universities.

"The University of Sheffield" was proposed by Commander E. H. M. Nicholson, D.S.O., R.N., who said that if Sheffield University could afford to carry on research on more extended lines industry would benefit in greater proportions.

DR. W. H. HATFIELD, replying on behalf of Sheffield University, said that whilst their first thought must be the education of the present undergraduates, their second thought was always how far they could be helpful in either developing knowledge or passing that knowledge for application in the great industries of the country. It was a fact that in the matter of research, Sheffield University had contributed very largely in creating that stock of knowledge without which it was impossible to develop the technology of the iron and steel trades. He thought it was extremely deplorable that at the present time matters were not unduly rosy financially for the University. He had the pleasure during the late autumn of touring the United States and Canada, and he delighted in the opportunity of stating facts concerning the universities of both the United States and of this country. It must be obvious to everybody that the ordinary schools did the bread-and-butter work of teaching the population to read and write. It was the effort of the universities in higher education which was going to determine our ability, from the intellectual point of view, of maintaining our position amongst the nations. It was an undoubted fact that the universities of this country were at a tremendous disadvantage because of the lack of financial resources. It was a fact—they would hardly credit it—that when he visited Harvard University he was told that that institution had recently received five million sterling. More than a dozen of the American universities would shortly have at their command anything from five to fifteen million sterling. Resources of that kind were absolutely necessary if they were to maintain the intellectual progress of a state. Unless they pumped into industry year after year the necessary supply of knowledge in the brains of their young men, unless they had the trained mind in industry, this dear old country England would not be able to hold its own. Education in the real sense was proceeding apace in the United States to a degree not really appreciated over here. The Americans themselves admitted that the main quality of the English population must be considered really in advance of that of their own population, but if the latter assiduously took enlightened means of getting the best out of their population and we did not, we should be left behind. He pleaded for more adequate financial resources to be placed at the disposal of such institutions as universities. It was a fact that in the United States, with very high tariffs, which could not be penetrated except under difficult circumstances, 120 million people, by taking in their own washing, supported themselves in a very high state of civilisation from the material point of view. As a scientific man it occurred to him that 40 to 50 million people constituted a very great market, and he was not so sure that it would not be a bad idea to ensure that we had that market to ourselves. He was not speaking as a politician—it was economics. The only argument against it was that we could not do it. Surely they had the brains amongst them to temper any conception of that kind by adjustments fitting the circumstances.

He felt confident that it was sheer folly to permit their own market to be so tangled as was the case to-day. What he was saying was a hard economic statement of fact, and there was no controversion of it, and the sooner parties realised that it was not a political question, but one that could be settled by the big minds in industry as a thing apart from politics, the better it would be. If what he was recommending were carried out there would be money available for the universities.

Continuing, Dr. Hatfield criticised the talk about British steel castings not being equal to the quality of those produced abroad. The steel cast-

ings produced in Sheffield foundries were, from the point of view of quality and freedom from defects, superior to anything that was produced in the world. He ventured to suggest that if the symposium concerning the quality of steel castings had been placed in the first instance in Sheffield, where steel castings were made, then perhaps the originators of the idea might have been put in their place.

Dealing with the problem of assimilating the Papers of many scientific institutions, Dr. Hatfield commended to those who were not learned in the art of reading a great mass of literature the excellent series of abstracts which could be found in some journals. It was possible by means of those abstracts to get a right idea of the work that had been done during the year. Anybody interested in keeping a complete view of the whole technical work of the year could not do better than keep in touch with one of the institutions dealing in those abstracts. It had been said that they could have too many institutions. Time would show that duplication of institutions rather than combination must necessarily take place. Knowledge became more and more specialised as time went on.

In conclusion, the speaker said the metallurgical department of Sheffield University would always be extremely delighted to consider any suggestions on research that the foundrymen might put before them. Professor Desch had the greatest facilities at his disposal, having a practical steel-making department where he was carrying out very important work for the Iron and Steel Ingot Committee.

The BRANCH-PRESIDENT remarked that the British Cast Iron Research Association had obtained the highest grant ever awarded by the Privy Council for any industrial research in this country. That award was the outcome of extraordinary effort on the part of the Association.

Progress of the I.B.F.

"The Institute of British Foundrymen (and the Sheffield Branch)" was proposed by MR. P. B. HENSHAW. When he thought of the foundries of the old days and the foundries as they were to-day he was not as disturbed as some members might be with what Dr. Hatfield had said. Money was a wonderful thing, but he had yet to learn that a vast amount of money was going to make their universities what Dr. Hatfield thought the American universities were. From what he (the speaker) had seen of the foundries during the last 25 years, the wonderful improvements that had been made from the resources and energy that those who were engaged in them were putting into their work, he had no fear for those vast millions that America possessed. Sometimes they were a great hindrance. From the hard times through which they were passing he thought British foundrymen would find their salvation. The tremendous improvements that had taken place in foundries was really remarkable, and he thought the Institute had played a very great part in that improvement. Of all the organisations he knew he thought the British foundrymen was perhaps the most active. They were one of the few bodies that could week by week produce an organ that was well worth reading, and which was acknowledged in all countries as being perhaps the very best organ published in connection with the foundry trade. He had no fears for the future. They would all have their own views on whether political measures would help them, but he thought that the future really rested with themselves. By dint of perseverance, by putting all they knew into their work, by using every method of research that was open to them, he thought they would so improve their product so that it would stand not at the bottom of the ladder but at the very top.

The PRESIDENT OF THE INSTITUTE, replying to the toast, urged members to read the articles in the symposium referred to, as they in Sheffield knew what steel was. He wanted them to see the statements made in Scotland about steel and put forward statements that would contradict them. He thanked Mr. Henshaw for the very kindly way in which he had proposed the toast of the Institute and of the Sheffield Branch. In years to come they would look back upon this time not with the painful feelings they had now but with feelings of thankfulness that they had put their house in order. Many of the modern foundries were wonderfully equipped places; no country in the world could show them anything. It was surprising to find how many of the smaller foundries regularly employed their consultant. Mr. Firth had referred to the wonderful accessibility of knowledge and free interchange of ideas that existed to-day, and he (the speaker) thought that was mainly due to the work of the British foundrymen. The Institute was doing good work, but it could not get on if the Branches would not work. If the Branches ceased to function the Institute would die. The Branches worked more vigorously every year, success depending upon the Papers given at the meetings and the discussions which followed.

The health of the Branch-President was drunk on the call of the MASTER CUTLER.

Sir W. G. Armstrong, Whitworth & Company, Limited.

Details of Reconstruction Scheme.

Details of the proposals for the reorganisation of the capital of Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, have now been sent to the debenture stock holders, note holders, preference and ordinary shareholders of the company. It was indicated as long ago as December, 1926, when the debenture holders were asked to grant a moratorium, that a scheme for the reconstruction of the company would be presented for the shareholders' approval. As was foreshadowed, the proposals are of a very far-reaching nature. Losses of a capital nature, in respect of depreciation of property and losses on investments, amount approximately to £11,484,667. This sum, together with £2,632,869 required for further provision in respect of investments and for the deficit on profit and loss, makes altogether £14,117,536 to be provided for. Of this amount over £10,500,000 is accounted for by the writing down of the property account, the loss on the realisation of the Newfoundland investment, the loss on the S. A. Armstrong di Pozzuoli investment, and the loss on the Pearson and Knowles Coal & Iron Company, Limited, investment.

Features of the Scheme.

The scheme provides for the formation of two separate and distinct companies, one to control and operate Scotswood Works and Close Works, and the other to control and operate the shipyards. Sir W. G. Armstrong, Whitworth & Company, Limited, as at present known, will become a holding company, and in addition to investments in various undertakings, including Vickers-Armstrongs, Limited, will for the time being control or be allied to the following concerns, the last four through the Pearson and Knowles Company:—Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited, Sir W. G. Armstrong, Whitworth & Company (Shipbuilders), Limited, Craven Bros. (Manchester), Limited, Pearson and Knowles Coal & Iron Company, Limited, Partington Steel & Iron Company, Limited, Rylands Bros., Limited, Moss Hall Coal Company, Limited, and Wigan Junction Colliery Company, Limited. Each subsidiary or allied company will thus be in a position to contemplate working or other arrangements with other companies carrying on similar businesses.

Position of Security Holders.

The scheme provides that the 4 per cent. mortgage debenture stockholders, who rank first in order of security and claim on the company's properties and assets, will continue so to rank on the assets of the reconstructed company, but they will have a floating charge instead of the existing fixed and floating charge, which will be cancelled to enable the company to give effect to the scheme. The total of the 4 per cent. mortgage debenture stock is reduced from £2,500,000 to £1,036,014. The amount of the assets of the company will, after writing off all losses and contingencies and all trade creditors, cover the 4 per cent. debenture stock about six times over.

The 6½ per cent. second mortgage debenture stockholders and the 5½ per cent. note holders, after eliminating the amount held by the bankers, are offered £3,500,000 (the par value of their stock and notes) in 5 per cent. income debenture stock (with a 1 per cent. cumulative sinking fund) and shares in a new company (the A.W. Second Stock Trust, Limited) to which will be transferred and allotted by Armstrongs a like nominal amount (£3,500,000) of securities. The consideration to Armstrongs will be the discharge in full of all claims by the 6½ per cent. second mortgage debenture stockholders and by the note holders for principal and interest.

Agreement with Bankers.

The 6½ per cent. consolidated mortgage debenture stockholders, after eliminating the £2,408,000 held by the bankers, are to receive income debenture stock in a new company (the A.W. Consolidated Stock Trust, Limited) to the extent of £67 10s. for every £100 of their present holdings. One million fully-paid 6 per cent. "B" preference shares of £1 each of Vickers-Armstrongs, Limited, are to be transferred and 750,000 new fully-paid 4 per cent. second non-cumulative preference shares of £1 each of Armstrongs are to be issued to the last-mentioned new company, which is to give a floating charge upon its undertaking and assets in favour of the trustees for the benefit of the 6½ per cent. consolidated mortgage debenture stockholders in respect of their holding of income debenture stock for approximately £1,750,000. As in the previous case the consideration to the company will be the discharge in full of its debt to the 6½ per cent. consolidated mortgage debenture stockholders.

The company's bankers have agreed to accept £2,350,000 in new "B" ordinary shares in full settlement of their claims.

The shareholders will get "A" ordinary shares of 1s. each in the reconstructed company, these shares being entitled to 10 per cent. of the equity in the company. The first preference shareholders get 15 shares of 1s. each for every £5 share now held, or 3 shares of 1s. each for every £1. The second preference shareholders get 2 shares of 1s. each for very £1 now held. The third preference shareholders get one 1s. share for every £1 held. The ordinary shareholders get one 1s. share for every £2 held. If the "A" ordinary share capital is increased it must be first offered for subscription to the holders of shares of that class.

An extraordinary general meeting of the company is to be held at the Central Hall, Westminster, on February 19 to consider the proposals. Shareholders will be asked to pass resolutions, reducing the capital of the company from £11,012,500 to £1,512,812 10s., divided into 200,000 4 per cent. first cumulative preference shares of 15s. each, 1,000,000 5 per cent. non-cumulative second preference of £1 each, 1,000,000 5 per cent. non-cumulative second preference of 2s. each, 2,500,000 6½ per cent. non-cumulative third preference of 1s. each, and 5,512,500 ordinary shares of 6d. each, such reduction to be effected by cancelling capital which has been lost or is unrepresented by available assets to the extent of £4 5s. on each of the existing 4 per cent. first cumulative preference shares of £5 each, 18s. on each of the issued 5 per cent. non-cumulative second preference shares of £1 each, 19s. on each of the 6½ per cent. non-cumulative third preference, and 19s. 6d. on each of the ordinary shares. Upon the capital of the company being effectively reduced to £1,512,812 10s. and the scheme of arrangement being sanctioned by the Court, the capital is to be increased to £11,012,500 by the creation of 1,000,000 6 per cent. first non-cumulative preference shares of £1 each, 1,100,000 4 per cent. second non-cumulative preference shares of £1 each, 21,673,490 "A" ordinary shares of 1s. each, and 12,632,026 "B" ordinary shares of 10s. each.

Acceptance Strongly Recommended.

The scheme is to take effect as from December 31, 1928. It is pointed out to the shareholders that but for the manner in which the bankers have agreed to meet the position, nothing short of the liquidation of the present company and the sale of the undertaking and assets for the benefit of the debenture stockholders would appear to have been possible. The advisory committee representing all classes of debenture stockholders and note holders, having fully considered the scheme of arrangement for reconstruction in all its bearings, recommend the adoption of the scheme. In so far as the shareholders are concerned, the directors of the company, and their financial advisers, strongly urge acceptance of the scheme. They state that the proposed participations for the shareholders could in their view only be obtained if the scheme is adopted, as under a receivership, which appears to be the only alternative, it is quite improbable that there could be any such outcome.

Foundry Query.

Chill Casting.

I should be much obliged if any of your readers could give me a brief outline of the method generally adopted for the chill-casting of gun-metal and phosphor-bronze bushes. These bushes are about 7 to 8 in. long, and 3 in. external and 1⅞ in. internal diameter.—E. W.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of THE FOUNDRY TRADE JOURNAL.

Steel Castings.

SIR,—Referring to the closing discussion of the "Symposium of Steel Castings," which appeared in your issue of January 17, is it not the aim of every foundryman to achieve perfection, but is this possible in every casting? When the Admiralty seeks to reduce the weight of castings to a minimum, and expects perfection, extra care and precaution must be taken to ensure a perfect casting. The designer *must*, therefore, do his utmost to help the foundry. With thin steel castings of considerable area many difficulties are experienced. Air and gas locks are a source of trouble and are sometimes hard to overcome; also tears and pulls are more frequent because the mould has to be cast as hot as possible, which means increased contraction. Solidification is more rapid, and if everything is not of a uniform nature the result is a faulty casting. In this sectional work *chilling* plays a very prominent part, and is preferable to *brackets* for this sort of work. To use chills means a little more time and attention to the work, but the results justify this, and without doubt thinner castings can be made satisfactorily. This is particularly so if convertor steel was allowed to be used in the production of thin castings, more so than if using electric furnace steel, because by the addition of ferro silicon, steel can be made very hot, and there would be no difficulty in passing the required tests.

Undoubtedly a foundryman can judge with greater accuracy than the engineer the probable result of making a casting as soon as he sees the pattern. When a large number of castings is required it would certainly be advantageous to make a few, and remedy any necessary faults before proceeding with the remainder. But will the demand for quick delivery allow for this? I read further on that "unless care is taken in the foundry the efforts of all others—the designer, patternmaker and the metallurgist—would be absolutely thrown away." Cannot this be paraphrased as: "If great care is not taken by the designer, the patternmaker and the metallurgist the foundry's effort would be thrown away"? The essential factor is co-operation of all parties. If the Admiralty requires castings which are thinner to reduce weight, yet sufficiently strong to withstand high pressures and temperatures, I should say that the only possible solution would be to adopt alloy steels in the place of ordinary plain carbon steels, alloy-steel castings would certainly give good results when tested, and although they would naturally cost more, because of their high qualities, they should prove to be the most economical in the long run. Alloy steels demand extra precautions in the heat treatment, because of the great variation of effects and results, which can be obtained by this. Quenching in oil and water is employed in the heat treatment of alloy steels to secure certain results. Would a chromium-vanadium steel meet requirements for work where weight has to be reduced, yet high pressure and temperature withstood?

I should say it would, because chromium decreases the tendency of crystalline growth, and gives the steel fine or dense grain. Combined with nickel or vanadium, this element gives the strongest and most durable commercial steels which can be machined easily.

The following table by Sir Robert Hadfield gives the mechanical properties of chromium-vanadium steels:—

Carbon content, percentage ..	0.4	0.25
Steel quenched at	870 deg. C. in oil.	850 deg. C. in water.
Tempered at	650 deg. C.	650 deg. C.
Elastic limit, tons per sq. in...	45	50
Maximum strength, tons per sq. in...	62	54
Elongation, percentage ..	20	27
Reduction of area, percentage	57	70

Vanadium is considered to be a powerful deoxidising agent, and that it increases the molecular cohesion and imparts a finer and denser structure than that of an ordinary carbon steel. Vanadium promotes the even distribution of carbon and prevents constitutional segregation.

Castings, such as valves, are undoubtedly very important, and, if cast in straight carbon steels, suffer from corrosion. If these castings are to be cut down to a fine limit corrosion must be taken into account, but the use of alloy-steels would almost eliminate corrosion, and, at the same time, give castings capable of withstanding high temperatures and pressures. Ordinary plain carbon steels high in silicon would eliminate corrosion to a great extent, but the silicon content would affect other properties required.

In nickel-steel the nickel has a beneficient effect by making the structure finer and homogeneous. It is said to hinder the segregation of carbon and the metalloids, and, without a doubt, segregation of carbon is very often responsible for hard spots in steel castings, which can, however, also occur through the faulty addition of alloys to steel baths, particularly in converter processes. A nickel-steel containing from 2 to 4 per cent. nickel and carbon 0.2 to 0.5 per cent. is used for marine forgings, guns, frames and engines for motor cars, bridges of extra large span, and also to a considerable extent for making tubes of high grades which are cold drawn. The uses of this alloy steel alone recommend it for any castings which demand quality of material, reduction of weight and homogeneity, etc. In chromium steel a chromium-content of 1 to 2 per cent. gives the steel a great hardness, and decreases the tendency of crystalline growth, giving the steel fine or dense grain, a desirable feature for such work as valves. Chromium-steels are responsive to heat treatment, for chromium intensifies the sensitiveness to quenching, and reduces the liability of fracture. It increases the elastic limit and gives maximum strength without appreciable loss of ductility. Mention is made of casting "flat" or horizontal. Even with the use of more steel for heads, I am afraid that in many instances sound castings would be difficult to obtain. A good practice is to make a casting feed itself as far as possible and this would be impossible if many castings were cast horizontal.—

Yours, etc.,
W. BARKER.

136, Nidd Road, Attercliffe,
Sheffield.

Carron Company's Staff Dinner.

The annual staff dinner of the Carron Company was held recently in the Dobbie Hall, Larbert, Mr. George Pate, O.B.E., J.P., general manager, presiding, supported by Mr. F. L. Burder, chairman of the Carron Company, Mr. C. M. Brown, secretary, Messrs. Conninsby Clark, H. H. Brown and H. E. White, and the departmental managers.

Mr. George Pate, in the course of a speech, referred to the gift of the Maclaren (Carron) Memorial Park, Stenhousemuir, in memory of the late Mr. J. J. S. Maclaren, who was for many years chairman of the company, as indicating the interest of the directors in the well-being of the community. The toast of the Carron Company was proposed by Mr. J. Higgins, advertising manager. Referring to the early work of the founders of the company, he said that from them had grown an organisation which was now in the front rank in the industrial world, and whose products knew no geographical boundaries. Mr. Higgins referred to a letter written by Samuel Garbutt to another of the founders of the company, in which he said: "Our reputation at setting out is of great importance. . . . I hope we shall have the first reputation for quality of our goods." This had been the company's policy throughout the 170 years which has passed since its inception—a policy which had earned for the Carron Company's manufactures the high reputation which they now hold. It was for them to see that the standard of efficiency and progress was maintained. Mr. Burder, in replying to the toast, reviewed the work of the company, and made special reference to the blowing in of another furnace and to the success attending the addition of the steamer "Forth" to the Carron Line. Mr Burder concluded with an expression of the directors' thanks to the staff, without whose loyal co-operation and support their efforts would be in vain.

Random Shots.

Continuing some quotations last week from Mr. Everton's "Hammer of Doom," Shardlow's idea for improving castings is, according to the hero, as follows:—"When iron is molten it's a non-conductor of electricity, and Shardlow has found out how to make it a partial conductor just at the important time when it's solidifying. He adds some powder or other to the iron in the ladle. No one knows what it is, and he's as secret as a safe. Morson has analysed some of the castings, and he can't find anything. He adds the powder to the metal when it's molten, then, just as it's setting in the mould he passes an alternating current through the casting. And it works. I've seen some of the castings broken up, and they're simply beautiful—there's no other word for it. The electric oscillations seem to make the crystals small and to break up the graphite plates, and as the thin portions of the casting generally offer more resistance than the thicker parts, so most of the current passes through the thick parts—it evens itself out just where it's most wanted—it's great!"

* * *

Well, it is undeniably interesting to read a yarn about the kind of place and people and industry of which you know something, and doubtless Mr. Everton will find many readers, not only around Chesterfield, but throughout the industry. I hope, however, that nobody will be tempted to spend time and money applying alternating currents through molten iron. The sand in the mould would prove a trifling obstacle to be surmounted, unless he proposed to make electrical contacts with red-hot runners and risers. As a matter of fact, the only effect of a current would be to raise the temperature of the metal a trifle, as one of his "damned societies" could very quickly have told him. The book takes its title, by the way, from a gigantic steam hammer which kills the unfortunate Shardlow.

* * *

The first and most obvious result of the King's convalescence at Bognor will be to restore the South Coast to favour among fashionable holiday-makers as distinct from ordinary folk like ourselves. In increasing numbers ever since the war these lordly ones have sought their pleasures in France, Belgium, Switzerland, Italy, and in some cases Egypt and the Canary Isles. And since they go, not for any great local advantage, but rather because other people go and it is the thing to do, perhaps they will decide to buy British goods for a change.

* * *

The obvious and immediate result will be, I hope, an improvement in the standard of hotel-keeping and entertainment generally. The consequence of this may well be an influx of foreign visitors and the spending in this country of money that has latterly been spent on the other side of the Channel. The hotel-keepers and coastal boroughs will be the first to benefit, but their demand for more goods will stimulate production, and any stimulus to production is bound to interest us very vitally, since a greater demand for almost any class of goods you like to name will in the long run mean a greater demand for the products of the foundry.

* * *

If you are sceptical as to the effect of the King's convalescence on foreign fashions in holiday-making, let me give you an example from my own experience to prove that the matter is one in which people on the Continent are keenly interested. MARKSMAN was astonished the other day to receive a purely personal letter from a French friend, which wound up, amid the usual family inquiries and greetings, with expressions of condolence in the matter of the King's illness, and assurances of interest and sympathy. Foreigners are not, as a matter of fact, quite as exclusive about us as we are apt to be about them!

MARKSMAN.

The Measurement of the Cupola Air Blast.—III.

BY "METER."

The Selection of a Meter.

Whatever type of air meter is selected, it is usually a comparatively expensive instrument. Already at the outset of these notes it has been indicated that the use of the air meter in the daily cupola practice is essential in determining the best and most economical operation of the furnace under any given conditions. On these grounds the expense of the air meter can be justified. Another aspect of the initial cost of these instruments is the necessity for the exercise of care and discrimination in selecting an instrument which will prove reliable and satisfactory.

In selecting a volume meter the decision as to whether the meter shall be of the simple indicating or of the recording type is the first one to be made. From many points of view this will depend upon the staff organisation and the extent of the daily contact with the plant by those who are responsible for the details of its economical operation. Where close daily contact is maintained there is no doubt that a simple indicating meter will suffice. In all cases a record is invaluable in scrutinising the detail of operation of the cupola. For this reason the expense of a recording instrument is advised. An instrument of the combined recording and indicating type will be found particularly useful in exercising close supervision of the cupola. Robustness of construction in all details is essential in instruments intended for daily use. Recording instruments in particular should be mounted carefully and rigidly if clear records are desired, and the usual precautions taken to ensure freedom from damp, dust and corrosive fumes.

Use of Venturi Tube Limited.

The application of the venturi tube, particularly to existing plants, is very limited by reason of the special care required in the incorporation of the venturi tube in the air main. The venturi tube, by reason of the comparatively large differential pressures possible, can be used for accurate measurement. For this reason this type of instrument has been used in investigation work on the cupola. For practical work the choice generally lies between the pitot tube, orifice plates or paddle type meters. As indicating meters the choice probably lies equally between each of the above types. The pitot tube is very convenient, and involves very little trouble in fixing in the pipe line, providing a length of straight main is available. The small differential pressures in this type of instrument necessitate comparatively delicate recording mechanism. The paddle type of meter can be made very robust, hence this type has been specially adapted for cupola work. The common type of indicator available for cupola work is the inclined liquid manometer. These are now constructed in a very robust manner, but in spite of this the foundryman will always have a preference for a dry type of meter.

In concluding these notes on the measurement of cupola air blast, it is necessary to comment upon the application of meters in cupola practice. The importance of exercising control over the air supply has been frequently emphasised. It must be admitted still, with considerable regret, that the value of the correct use of air meters is grossly under-estimated in many foundries—foundries who have amply demonstrated their interest in effecting economical operation of their cupolas.

With fan blowers the maintenance of pressure in the wind belt, or blast main, the usual location of the inevitable pressure gauge, is no indication of air flow as in the case of a positive displacement type of blower. The pressure indicated in a fan-blown system is greatly influenced by changes in the resistance to the air flow offered by the charge in the stack of the cupola. It is this circumstance that renders difficult and uncertain any attempt to arrive at the optimum working conditions without the aid of meters. From an engineer's standpoint the whole subject of efficiency and economy in the use of fuel in cupola practice, must appear confused and unnecessarily complicated. Cupola practice is still involved in arbitrary figures and ratios of traditional origin. It is capable, however, of scientific treatment on the identical lines of any other type of furnace and comparative thermal balance sheets can be constructed, and are the only satisfactory way of controlling the efficiency and economy of the utilisation of the fuel. It is somewhat surprising that the various improvements in cupola design and construction, claimed to bring about fuel economy, are rarely, if ever, substantiated by thermal-efficiency figures. Such are the only means whereby the claims for economy can be correctly established.

Thermal Balance Sheets.

The practical study of the thermal balance sheets of individual cupolas has been successfully used by continental investigators in obtaining considerable fuel economy. Piwowarsky and his collaborators have published detailed figures of a study on a particular cupola resulting in the reduction of the coke charge percentage to 6.29 per cent., a value almost equal to the most ambitious claims of many of the specially-designed cupola plants. This result was obtained on a small cupola of 28 in. dia., with a coke containing 10 per cent. ash, melting both low- and high-phosphoric irons, without loss of melting temperature and with increased rate of melting. The principal factor in securing these results was found to be the control of the air volume—and in this respect the use of the volume meter was a *sine qua non*. Details of the method followed, and very full abstracts of the figures obtained are to be found in a translation of Piwowarsky's Paper in THE FOUNDRY TRADE JOURNAL, August 13, 1925, pages 133 to 137, and are worthy of detailed study. It is specially interesting to note that the final results obtained in this investigation are not far removed from the theoretical limiting figure of 5½ per cent. melting coke. This figure was deduced by Thompson and Becker for coke of an ash content of 12½ per cent., and a molten metal temperature of 1,450 deg. C.

Much more attention has been paid in continental countries and in America to the effect of the variations in atmospheric conditions on the quantity of air supplied to the cupola. The extremes of the continental climate are greater than in this country, but even here their effect is by no means negligible. In fact the difference in operation of the cupola on a cold and frosty day compared with a hot midsummer day is a well-known and easily observed phenomenon. The three factors to be considered are the temperature pressure and humidity of the atmosphere. These vary with seasons and the altitude of the location of the plant. These considerations of atmospheric conditions invariably raise the point of the merit of expressing the air supply in terms of weight as distinct from volume. This question has been discussed frequently amongst foundrymen in this country. The calculations of the air supply to cupolas are based upon the weight of standard air at N.T.P., 760 mms. barometric pressure and 0 deg. C. or 15 deg. C. respectively. The weight of a certain volume of air changes with the change in temperature and barometric pressure, directly with the latter and inversely with the absolute temperature. The volume of air required at various temperatures and barometric pressures calculated to secure a constant weight of oxygen are given in Fig. 1 of Mr. H. V. Crawford's Paper, "Automatic Blast-Gate Control for Cupolas," which appeared in our issue of January 24. The figures are based upon a coke ratio of 8: 1, exclusive of the bed coke and a factor of 120 cub. ft. per min. of air at 15 deg. C. and 14.7 in. pressure used per pound of coke burned. Since the oxygen is the complementary fuel it needs no argument to demonstrate that the weight of oxygen supplied is the important feature of the air supply to cupolas. The influence of the variation in temperature and pressure on the quantity of air necessary to ensure constant weight of oxygen in the air supply, is more clearly demonstrated by the curves plotted in the figure. In this diagram the percentage of the volume at N.T.P. required is plotted against the temperature and the barometric pressure. These figures are sufficient to show that this influence of temperature and pressure on the volume of the air supply is by no means a negligible factor in the scientific operation of the cupola.

Effect of Humidity.

The effect of the humidity of the atmosphere has attracted considerable attention in blast furnace practice, and various methods of ensuring dry blast have been devised. In the operation of the cupola it is by no means certain that the presence of water vapour is harmful, and as yet there are foundrymen who believe that the presence of a certain amount of moisture is desirable. There are, of course, daily and seasonal changes in the humidity of the atmosphere, and of necessity these must have an influence on the working of the cupola. However, for the purposes of these notes, the changes in humidity can be neglected.

It has been found possible to design automatic controlling devices which can be applied to the blower system of the cupola to ensure the delivery of a constant weight of air or oxygen under normal conditions of variation in the density of the atmosphere. In the system* developed by the General Electric Company, of America, the controlling device is operated through the main supply current to the fan motor. The design of the fan is primarily such that its characteristics, or relation between the energy input in kilowatts and the delivery is almost a straight line laid over the normal range of its working capacity. Any change in the density of the air delivered is immediately reflected in a change in the kilowatt input into the motor, and this change is utilised in providing the automatic control. A balanced disc valve is inserted in the blast main between the fan and the cupola. The valve is opened and closed by means of a small fractional horse-power reversing motor. A contact-making ammeter is used to measure the current input into the main motor, so arranged that when the current input falls below or exceeds a certain predetermined value, separate contactors are energised operating the small valve motor, opening or closing the valve. By means of a regulating rheostat the current input conditions can be adjusted to a predetermined value, equivalent to a predetermined value of the weight of air delivered. This is automatically maintained by the apparatus. Naturally the correct conditions for a given cupola require to be properly determined.

A somewhat similar automatic control device is manufactured in Germany. In this case the control is operated by the reduction in pressure of the air delivery at the throat of a specially designed Venturi tube, mounted either on the inlet or the outlet of the fan blower. The pressure gauge is provided with adjustable contacts by means of which it is possible to operate a servo motor to regulate the motor driving the blower in such a manner that the latter maintains constant deliveries of air.

Wire Rope Research in America.—The study of wire rope and of the factors governing its life is to be undertaken by a research committee of the American Society of Mechanical Engineers under the sponsorship of the Engineering Foundation. Users of wire rope have found that its life in service varies greatly. Why this should be so has never been clearly understood. To throw some light on the matter, both makers and users of wire rope have expressed their willingness to support the large-scale investigations proposed by the above-mentioned society. It is planned, among other things, to construct a testing machine capable of reproducing at will the different service conditions under which wire rope is called upon to work.

* See our issues of January 24 and January 31, 1929.

American Exchange Paper.

The official Exchange Paper to be presented on behalf of the Institute of British Foundrymen to the Conference of the American Foundrymen's Association, to be held in Chicago in April next, will be prepared by Mr. Frank Hudson, of Kilmarnock. Mr. Hudson has chosen as his subject, "Science Hand in Hand with Labour," and will deal with the practical application of science to foundry practice. Among other subjects the Paper will deal with cupola methods, mould conditions, and sand testing and control.

Mr. Hudson was educated at Rutherford College, Newcastle-on-Tyne, and holds first-class certificate in iron and steel manufacture from City and Guilds of London Institute. He served his apprenticeship as a practical metallurgist with Sir W. G. Armstrong, Whitworth & Co., under Mr. H. H. Ashdown and Mr. Oliver Smalley, on armament and general engineering work, and at the age of 20 was given his first executive position as melting manager at the Close Works Iron Foundry of the above firm, making a special study of cupola problems and the production of refined

Mr. Frank Hudson.

iron and high-duty cast iron for Diesel engine and locomotive work.

In 1924 he was appointed metallurgist to the Government of Tibet to supervise the installation and manufacture of electric steel at Lhassa, but was advised at the last minute by the British Government not to go out due to political and religious unrest in Tibet. The expedition and machinery came to a very untimely end, as the convoy was massacred and the hydro-electric transformers and furnace thrown over the nearest precipice. From 1925 to 1927 he lived in Canada and the United States, and was associated with American Brake Shoe and Foundry Company, Chicago; Warren Foundry and Pipe Company, Phillipsburg, New Jersey; and Wyoming Shovel Works of Pennsylvania. At the present time he holds the position of Chief Metallurgist with Messrs. Glenfield & Kennedy, Kilmarnock, Scotland, the well-known firm of hydraulic engineers and valve specialists.

Mr. Hudson is a member of the American Foundrymen's Association, American Society for Steel Treating, and the Institute of British Foundrymen. He has contributed several Papers on foundry topics, being awarded a diploma by the Institute of British Foundrymen last year for a Paper on "Scottish Moulding Sands," and he recently presented a Paper to the Institute of Metals on "Scottish Moulding Sands and their Application to Non-Ferrous Casting."

The Influence of Some Elements on the Growth of Cast Iron.*

By O. Bauer and K. Sipp.

Important practical investigations have recently been carried out by the authors, in the foundry of a well-known Mannheim concern, regarding the influence of carbon, manganese and silicon on the phenomenon spoken of as the "growth" of cast iron. The authors, it will be noted, carefully distinguish between the two distinct phenomena of "primary growth" and "secondary growth," which in practice generally go on together, with the result that often it is not realised that two separate processes are involved.

1. The "growth" of cast iron (increase in volume under the influence of temperature), so much feared in practice, results primarily, at temperatures below the pearlite-point (below about 700 deg. C.), from the splitting-up of the cementite—free, or contained in the pearlite. At temperatures above 700 deg. C. the phenomenon is due to the separation of carbon from the solid-solution.

2. Theoretically, any iron-carbon alloy tends towards attaining the stable condition (ferrite-graphite). Next to the temperature, however, the period of heating plays an important part in this connection. The higher the temperature, the shorter is the time necessary; the lower the temperature, the greater is the length of time required for the process to be initiated or to proceed to an end. At normal temperature (about 15 deg. C.) the cast iron is apparently stable, as here the time-factor is of such weight that changes are well-nigh infinitely slow.

3. The plotting of a straightforward time-temperature curve applicable to all varieties of cast iron is, however, an impossibility—even at high temperatures, at which the primary process of the splitting up of the carbide or of the separation of carbon goes on comparatively rapidly—for, besides the time and the temperature, the chemical composition of the iron and the initial structure resulting therefrom and from the solidification conditions both play an important part.

4. With regard to the influence of Si, Mn and C on the primary growth phenomenon, the following may be said: (*a*) Silicon favours "growth" in a high degree; (*b*) manganese exerts a strong opposing influence to the power of silicon to promote growth, and (*c*) the influence of carbon, compared with that of Si and Mn, is but small. With a high silicon-content and a low content of manganese it certainly appears to accentuate the action of the silicon, but, if the manganese-content is high, carbon has no clear influence even when much silicon is present.

5. Concerning the effect of the initial structure the authors make the following remarks:—(*a*) If the ground-mass consists, in the main, of pearlite, there generally takes place at first, at temperatures below the pearlite-point, an agglomeration of the pearlite: it becomes granular, and only then does the decomposition of the carbide set in; (*b*) if free ferrite is already present, the ferrite set free by the splitting-up of the carbide crystallises on to that already existing, while the carbon separating out is deposited on the graphite-lamellæ already in existence, rendering the latter thicker and more voluminous.

Ferrite and graphite act, therefore, after the manner of nuclei. The formation of new graphite-lamellæ or rounded deposits of temper-carbon such as observed, for example, in the annealing of white cast iron could not be detected. (*c*) On annealing above the pearlite point (above 700 deg. C.) the structure of the ground-mass is entirely altered: the pearlite changes to the solid-solution (austenite). The arrangement of the graphite-network is, however, not at first affected thereby. When separation of carbon from the solid-solution commences though, the separated carbon is again mainly deposited on the already existing graphite-lamellæ, without leading to new and independent separations of graphite or temper-carbon. (*d*) The denseness of the casting is another determinative factor. The growth (split-

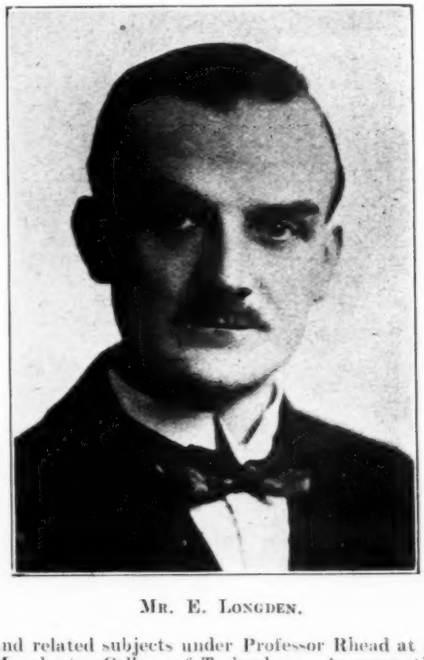
(*Continued on page* 132.)

* An abridgment of a detailed account appearing in "Die Giesserei," Nos. 41 and 42, 1928. The above translation summarises in a systematic form the author's main conclusions.

I.B.F. Branch President—No. 4.

Lancashire Section.

Mr. E. Longden, the President of the Lancashire Branch of the Institute of British Foundrymen, is manager of the foundry and patternmaking departments of Messrs. J. H. Hetherington & Sons, the well-known machine-tool and textile engineers, Pollard Street, Manchester. This firm has recently carried out an extensive reorganisation and improvement in their foundries. Other positions held by Mr. Longden include foundry manager to Tangyes, Limited, general engineers, Birmingham; foundry manager to the Premier Gas & Oil (Heavy) Engine Company, Limited (Crossley Bros.), Sandiacre, Notts., and head foundry foreman to Samuelson & Company, general engineers, Banbury, Oxon. Mr. Longden served as apprentice moulder and journeyman moulder with Royles, Limited, engineers and ironfounders, Irlam, near Manchester, and the British Westinghouse Company, Limited, electrical engineers (now Metropolitan-Vickers, Limited), Trafford Park, Manchester, in which firms he received a training in green-sand, dry-sand and loam moulding for castings up to 50 tons. He studied metallurgy



Mr. E. Longden.

and related subjects under Professor Rhead at the Manchester College of Technology. As a practical and technical foundryman he has devoted many years to methodical investigation and research in many directions relating to general foundry practice and cast-iron metallurgy, and contributed many articles to The Foundry Trade Journal, and delivered papers to the various branches of the Institute of British Foundrymen and engineering societies on foundry work. In 1923 Mr. Longden was awarded the Institute of British Foundrymen's Diploma for a paper on "The Relative Value of Feeders or Denseners in Grey Iron and Malleable Iron." Each year, from 1922, he has delivered one, and occasionally two, new papers, several of which have covered the cause and remedy of defective castings of which a special study has been made. He is a past member of the Councils of the East Midlands, Birmingham and Lancashire Branches of the Institute of British Foundrymen. In 1926 he accompanied the British delegation to the International Congress of Foundrymen held at Detroit, U.S.A. On this occasion an extensive tour was made of the foundries situated in the principal industrial areas.

Melting Point of Nickel.—The U.S. Bureau of Standards has practically completed a determination of the melting point of nickel, based upon two samples prepared in its own laboratories. The average value obtained was 1,454.9 deg. C., as against 1,452 deg. C., the value hitherto generally accepted.

The Westland Foundry.

It has been said, with some truth, that the average British foundry is not characterised by an excess of efficiency, but this is certainly not a criticism which can be levelled with the slightest justification at the Westland Foundry, attached to the extensive engineering and aircraft works of Messrs. Petters, Limited, Yeovil. Further, the Westland Foundry stands unique in the South West of England—unequalled for size and capabilities, for modernity in construction and mechanical equipment. At present it covers an area of over seven acres, but even so, it has become too small to cope adequately with the demands of the firm, with the result that here, as in all other departments of the works, important extensions are in progress. Built adjacent to the works, which are on the outskirts of the town, the foundry is connected by means of a private siding to the Great Western Railway Company's line, which runs directly alongside. The works can ship easily at Bristol or Southampton.

The fact that all sizes of engines from 1½ to 600 b.h.p. are made by Petters, Limited, means that the foundry work is both extensive and varied. Power is provided from the works power house, while a special department is fitted with air compressors and hydraulic pumps for machine moulding. The foundry buildings are all lofty, well lighted and ventilated, and fitted with modern mechanical equipment essential for rapid and accurate production in a foundry run on the most up-to-date lines.

Pattern Shop.

This well-lit shop is 115 ft. long by 62 ft. wide by 33 ft. high, and is fitted throughout with a Grinnell sprinkler fire extinguisher, manufactured by Mather & Platt. It is excellently equipped with machines supplied by Wadkin & Company, of Leicester, and E. S. Handley & Sons, Bourton, Dorset. The former have been responsible for a Universal pattern-making, sand-papering, planing and thicknessing machine, whilst the latter furnished the band and circular saws. Numerous lathes complete the machine-tool equipment. An adjoining room and a large cellar constitute the pattern stores. Both the store room and shop are provided with an adequate heating installation in order to prevent any distortion of valuable patterns, due to sudden changes in temperature and humidity of atmosphere.

By attaching to each bin an "in" and an "out" drawer, containing cards detailing the pattern number; the drawing number; a description of the pattern; and the number of core boxes and loose pieces, an excellent control has been instituted.

The Foundry Lay-out.

A general idea of the layout of the foundry is given by Fig. 1. It will be noted that in general the flow of the work is across the foundry, it being dispatched finally from the fettling shop, where motor lorries can back in to receive castings handled by an overhead crane. Two overhead electric travelling cranes of 5- and 15-tons capacity are utilised for transporting the ladles of liquid metal, the unfettled castings, heavy boxes, etc., whilst recently a new duty has been imposed upon them, that of shifting the sandslinger. It should be understood that since the transference of the heavy work from the Ipswich foundry to Yeovil much modification has been entailed at the Westland Foundry.

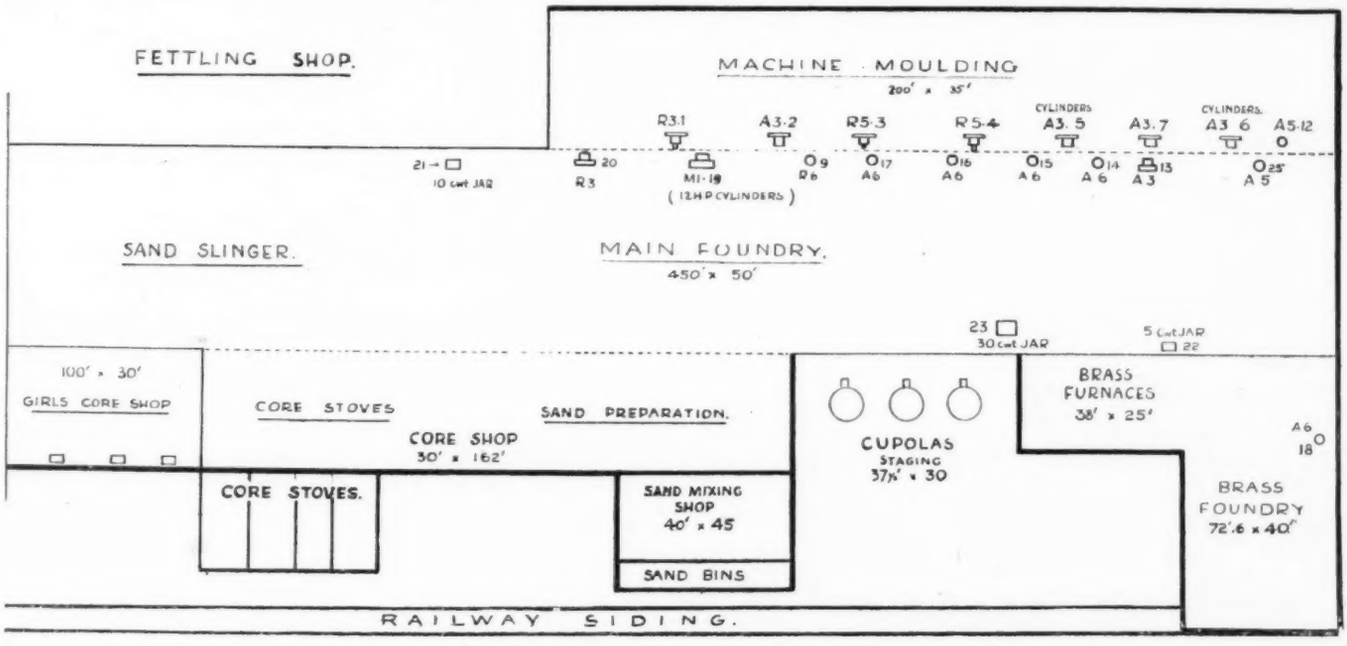


FIG. 1.—GENERAL ARRANGEMENT OF WESTLAND FOUNDRY.

Melting Plant.

The metal is provided by three cupolas of 8, 5 and 3, giving a melting capacity per hour of 15 tons. They are blown by a motor-driven Roots blower. A well-equipped chemical laboratory ensures an adequate control being maintained over the composition. In general a semi-steel cast-iron mixture is used in conjunction with Scotch and other high-grade pig-irons. At the time of our visit, Norths' Navigation coke was being used, and a melting ratio of 1 to 10 was being maintained. As much of the work is of a delicate character, this amount does not appear to be excessive. Hydraulic hoists carry the charges, weighed out in ½-ton bogies, to a roomy covered platform.

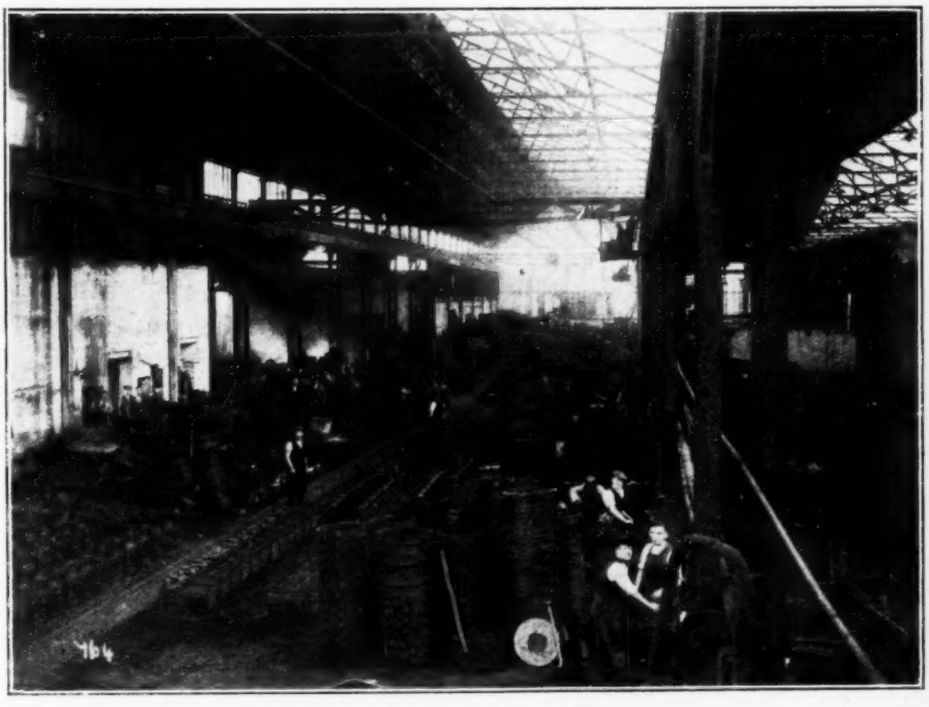


FIG. 2.—VIEW OF THE MAIN BAY OF THE WESTLAND FOUNDRY.

Sand Preparation.

As indicated in our plan (Fig. 1), the sand-mixing shop is well arranged. A number of doors are arranged on the outer wall communicating with bins capable of holding several truck loads of sand. There are two mixers, one being a Simpson, whilst aeration is taken care of by a Herbert centrifugal mixer. A feature of this foundry is the care bestowed on the blacking supply. The moulders draw their requirements from a large tub, the contents of which are maintained in motion by compressed air. This institutes a simple control often overlooked by the foundry manager.

Fig. 3.—The Girls' Core Shop.

Core Shops.

As female labour is employed two shops are devoted to core making. In the girls' department, three jar-ramming machines are installed. Each bench is provided with wire shearing machines, whilst special bending jigs are in use for the making of certain complicated cores. Several Worthington core-wire straightening machines are installed. The oil-sand mixture used is a blend of Leighton Buzzard sand and either Glyso or Spermoline or similar proprietary brand. Mixing is effected in a Blystone puddle machine. Much use is made of "carriers," or "driers" (the latter designation we consider to be incorrect). Drying is effected successfully at higher temperatures than is considered suitable by most foundry managers. The majority of the thermographs inspected by us show that a temperature of approximately 600 deg. Fah. (315 deg. C.) is rapidly attained and maintained for an hour or so, after which it sinks to, say, 480 deg. Fah. (say, 245 deg. C.) for 7 hours. Two hours later, the oven cools down ready for the withdrawal of the cores. We feel that the success achieved must be associated with a rapid change of atmosphere in the ovens, and we would advise any founder who wishes to emulate the Westland practice to make sure of this point.

There are four core stoves, all 10 ft. high. Two have an area of 30 ft. × 11 ft., whilst a larger one is 30 ft. × 14 ft., and a smaller one 30 ft. × 10 ft. These are supplemented by a small standard Portaway stove. The carriages are removed from the stoves by snatch blocks using the overhead cranes for pulling. They are fired by separate gas producers supplied by R. and G. Hislop, of Paisley. These producers are partly above and partly below floor level. Gas is produced from ordinary gas coke burnt to destruction. It is possible, however, to utilise sawdust as fuel. Moisture is withdrawn from the front of stoves through openings in the floor connected by fireclay flues to the main chimney. A very complete pyrometric installation registers on thermographs the complete thermal record of each cycle of operations.

Moulding Equipment.

The foundry is very completely equipped with a large variety of moulding machines. There are installed nineteen hydraulic machines by Bonvillain et Ronceray, of Paris, and nine pneumatic jarring machines by the Britannia Company, MacDonald and Mumford. It is in the hydraulic section that this foundry has acquired something of an international reputation, on account of the control it exercises on the pressure to be exerted on any one type of mould.

The most recent innovation in this foundry has been the installation in the heavy section of a portable sandslinger. The perfection to which this machine has been brought, is exemplified by the assertion of Mr. Derry, the foundry manager, that he has never in his career installed a new machine which has caused such little trouble in putting into commercial operation.

Moulding Boxes.

Cast-iron moulding boxes are used throughout the foundry. Accuracy of fit is ensured by the use of hardened steel pins fitting into white-metalled holes prepared from jigs. This system is working well, and a "life" of twelve months before rebushing is being regularly obtained.

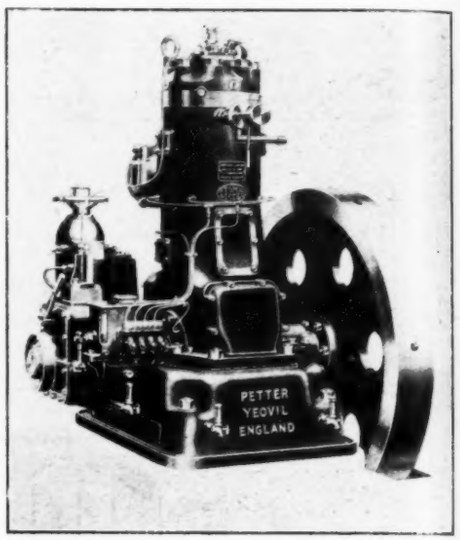


Fig. 4.—The Latest Petter 25-b.h.p. "T" Type Atomic Diesel Engine.

Brass Foundry.

The activities of this department are fairly well confined to the production of gunmetal bearings and aluminium gear cases. Metal is melted in two ordinary pot furnaces.

Fettling Shop.

A Tilghman sand-blast room with a 12-ft. square chamber and a cabinet by the same maker take

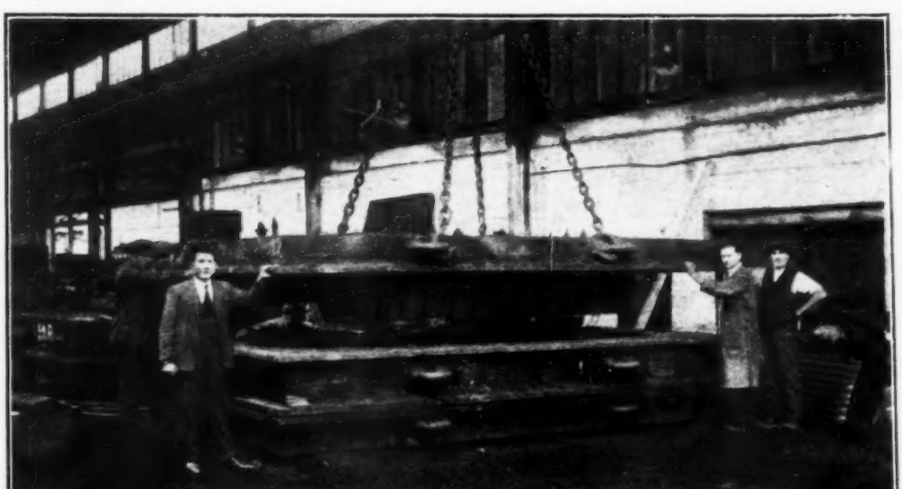


Fig. 5.—Scene in the Westland Foundry, showing the Mould of the Bed of a 350-h.p. Petter Engine being Placed in Position for Casting.

care of the whole of the production of the foundry. There is also a very complete installation of emery wheels all properly provided with dust extracting ducts to conform to the Home Office Regulations. There are set-ups for water-pressure testing of cylinders and cylinder heads. The end of this shop is taken up by the despatch department, where a 5-ton overhead travelling crane can load the castings into lorries or railway trucks.

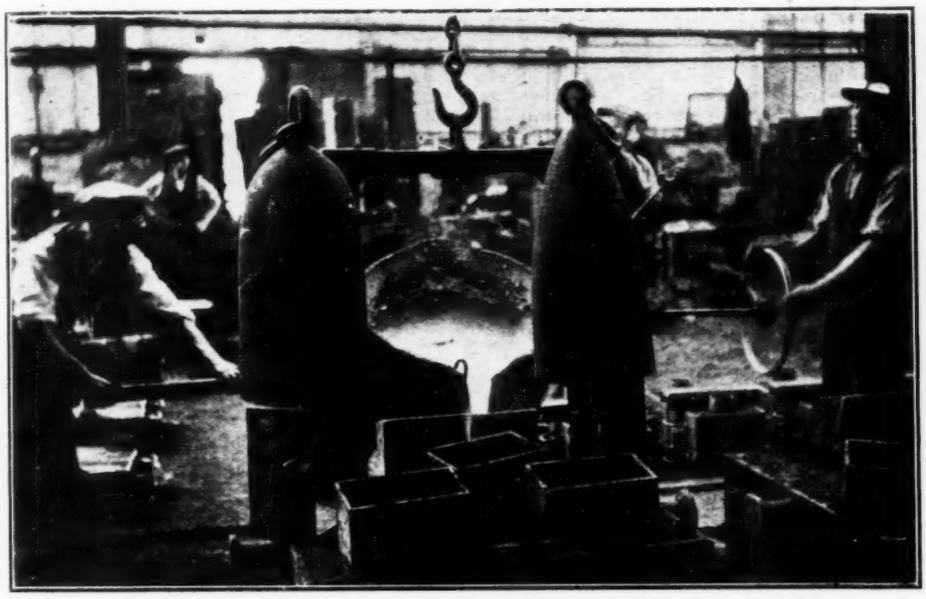


FIG. 6.—CASTING AT PETTERS OIL-ENGINE WORKS.

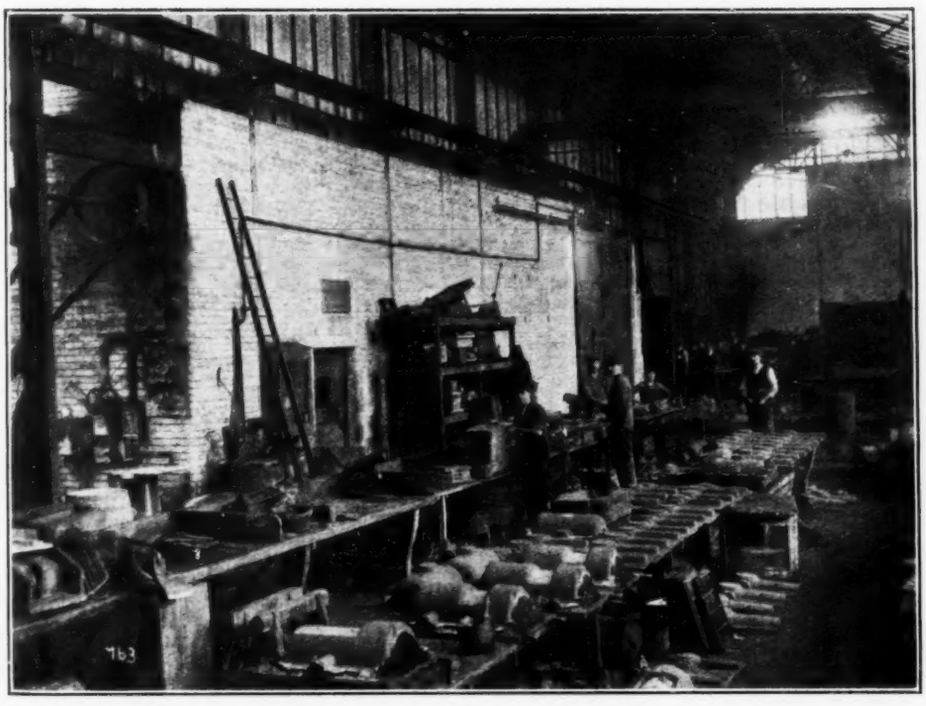


FIG. 7.—THE MEN'S CORE SHOP.

In conclusion, we wish to acknowledge with thanks the help we have received in preparing this article from Mr. L. B. Derry, the foundry manager, and Miss I. H. Thompson, of the publicity department.

AT A RECENT meeting, held in the Applied Science Department of Sheffield University, by the Foundry Society, Mr. J. T. Griffiths gave an address on "Core-making for Steel Castings."

Sands for Oil-Sand Cores.

Writing in "Die Giesserei" (No. 38, 1928), Dr.-Ing. Rudolf Stotz, of Düsseldorf, discusses the requirements to be looked for in "quartz sands" for oil-sand cores, and also some of the points that have to be studied in practice to avoid disappointments. With regard to the properties required of moulding sand and the methods of examination and testing to be applied, definite data based upon elaborate investigational work are available. Regarding core sands, however, there is, unfortunately, but little to be found in the literature. This latter class of sands can be divided into two main groups:—(1) River and sea sands, termed "sharp" sands, which consist of almost pure quartz and cannot be used without the addition of an artificial binder, and (2) moulding sands, dry sand, and loam with a natural content of clay as binder, and also with the simultaneous addition of artificial binding agents.

The author confines himself to consideration of the sands of the first group, as the technical and economic benefits to be derived from the use of oil-sand cores have not, in his opinion, been as yet sufficiently appreciated. These benefits, compared with ordinary sand cores, centre above all in the ability to produce the most complicated cored castings while keeping cleaning costs down to a minimum, and at the same time obtaining a very clean finish.

The requirements called for from any core sand are, briefly, plasticity, refractoriness, gas permeability and strength. Demands in the way of plasticity are in certain cases dependent upon the method of preparing the core—whether the core is rammed by hand, made on a machine, or by a pneumatic sand thrower. The plasticity is obtained by suitable admixture of core oil to the—in itself totally non-plastic—silica sand. An indispensable factor is the intimate mixture of the sand with the added bond by the aid of good mixing machines.

The refractory qualities of oil-sand cores are not, in the case of large cores of massive castings, so good as those of cores containing clay, as, owing to the greater incandescent effect of the larger masses of iron in the thicker castings, the organic binder is burnt before solidification of the iron is complete, and the core thus loses its strength too early. Although clay is highly refractory, there appears, with increasing clay contents, the disadvantage of hard cores, with consequent increased cleaning costs.

Serious Effects of Impurities.

Sand for oil cores should therefore consist of silica of the highest possible purity, this possessing a melting point of over 1,700 deg. C.—thus well above the temperature reached with molten iron. It is important that the sand should contain no lime or alkalies, as these lower the fusion point of the quartz and cause the sand to be burnt on to the casting. The presence of calcium carbonate also may lead to blow holes in the castings due to the carbonic-acid gas set free in the sand on pouring, while a content of alkali would saponify a portion of the core oil.

A considerable number of the core sands described in the trade (in Germany) as "silica sands" were examined, with the result that it was shown that the designation "silica sand" was by no means a guarantee of pure silica and freedom from clay. Of twelve samples reported on, the minimum clay content was 0.15 and the maximum 12.60 per cent. Half the samples contained from 2 to 6 per cent. This amount of clay in sand for oil cores is objectionable; for one thing, it soaks up a part of the core oil, and thus necessitates the use of a larger quantity of this expensive constituent. Arrangements are therefore advisable, in the sand-dressing department, to remove the "silt"—largely consisting of clay—from the core sand. By this process, both the strength and the gas permeability can be raised, as the following table shows:—

Effect of Silt Removal.

	Transverse strength.	Gas permeability.	Clay content.
Before removal of silt ..	14.0 kgs.	265 ccs/min.	6.3% Al_2O_3
After removal of silt ..	22.2 kgs.	306 ccs/min.	4.7% Al_2O_3

The gas permeability of cores is very greatly influenced by the shape, size and uniformity of the grains. With decreasing grain size the permeability naturally becomes, in general, less, but it must be borne in mind that even if a sand is of a mainly coarse nature with large grains, the presence of a certain proportion of fine grains may block up the interspaces between the large grains and bring about extremely poor permeability. The author gives photographs, taken in the course of comparative investigations of various German sands, which show this point very well.

Grain Size and Strength.

Another property which is strongly affected by the grain size is the strength of the core. Experi-

(*Continued on page* 129.)

Impressions of French Ironfounding.*

By J. STANWORTH, M.B.E.

About eighteen months ago the author spent a few weeks in France working at a French foundry. The patternshop consisted of three main parts; the ordinary wood-working patternshop, the metal-pattern shop, and a very small moulding shop where plaster blocks and patterns in soft metals were made. Almost all the patterns were for making fairly large quantities of castings, and were usually made first in wood, then cast in zinc, aluminium, or an alloy of lead and antimony. These were then filled up and taken into the small moulding shop for a plaster block to be made with them which was then sent to the main foundry. Most of the patterns were plastered in this way, though some of them went to the moulding shop to be moulded off in the ordinary loose pattern way.

The sand used in the small moulding shop was fairly fine, but very tough, and was of a dark brownish colour, the new sand being yellow, and of a similar type to the Belgian moulding sand.

In making the plasters for the foundry the moulder rammed the sand as hard as possible for easy tooling, and also to prevent it washing when he poured the plaster. When he had rammed both halves of the mould, he lifted the top and screwed short, bent pieces of steel about ¼ in. dia. into the patterns, usually two to each pattern, and these fastened the patterns into the plaster when it was poured. If a great number of castings were to be made from these plasters, extra patterns with hooks screwed in were placed on the top part in the slight impressions and the plaster poured as before. A special kind of plaster was used for the face, which was a little finer than the ordinary, and this was poured in and roughened up before the ordinary plaster was put in. As soon as this had set, the sand was washed off it with a small stiff brush, then trimmed off round the edges and wherever else required, and set on one side to dry for about two days before being varnished. The ordinary wood-working patternshop was not very up to date. A bandsaw, a lathe and a drilling machine were the only machine tools in the shop.

The metal patternshop was well equipped with rasps, bent files and scrapers. There was also a small charcoal fire for soldering irons, etc., which was blown by a geared hand-fan. In this department some of the patterns, such as stove tops, were made by soldering thick zinc sheets into the required form, whilst others were filed-up zinc castings made from wood patterns. No iron patterns seemed to be used.

Sand Mixing.

The first part of the foundry visited was the sand-mixing department. This was composed of a sand mill and aerator. The mill was of the rotating pan type, and instead of flat rollers there were grooved ones. These were kept about ½ in. from the bottom of the pan and were free to lift higher if required. This pan was excellent for mixing facing sand, though it would not be much use for loam. Another disadvantage of this type was that it was not self-emptying, and if anything sticky was milled, the spaces between the wheels were apt to be filled up. To prevent this as much as possible, bars were fixed on the machine between the rollers to act as scrapers. The aerator was a well-known type, and had a small disc inside a larger annular ring, each being studded with steel prongs. Both the disc and the annular ring were fixed to shafts running in opposite directions on ball bearings. The speed of each shaft was very high (perhaps 1,000—1,500 r.p.m.), and there was therefore much vibration, which effectually prevented the sand from lodging in the casing as is sometimes the trouble with this type of machine, especially when run at high speeds on a good foundation.

In this foundry, two kinds of facing sands were used, one for the press machine moulders and the other for the floor and bench moulders. Castings up to about 20 lbs. were made on the press machine and up to about 6 cwts. on the floor. The facing sand for the floor moulders had much more bond than that for the machine moulders, and also more coal dust. For the machine moulders the mixing was:—Thirteen shovels old sand, three to four shovels new yellow sand, two shovels sandy clay, and one-quarter to one-third fine coal dust. Very little water was added. This was milled, aerated and taken to boxes by the machines.

The mixing for the floor moulders was:—Thirteen shovels old sand, three shovels new yellow sand, two shovels sandy clay, and one-half to two-thirds shovels coal dust; or twelve shovels old sand, two shovels new yellow sand, four to five shovels sandy clay, and one-half to two-thirds shovels coal dust. This was treated in the same way, being milled and aerated.

Almost all the cores for the foundry were made in oil sand, which had a very good green bond. The mixing was:—three buckets dry sea-sand, one bucket dry yellow sand, and about one pint core oil. About two to three pints Avébene (a proprietary article). Yellow sand was evidently used for cheapness, and not to give the green bond since it was used dry. A large number of cores were required for gas-burner castings, and these were often like long clay pipes.

These were all made without cradles by two women. The method was as follows:—The bottom half of the box was rammed up and strickled off level, and a wire dipped in core gum and put in. Then the top half of the box was filled, but not rammed tight, and strickled off so as to leave the sand a little bit high, *i.e.*, above the box-joint. The bottom half was then put on it and the two knocked together with a mallet. Next the box was wrapped and one-half removed and the core emptied into the hand carefully before it was put on a soft sand bed on a plate ready for the stove.

This stove was one of the small self-contained ones with shelves which swing out on hinges, and, when fully opened, closed the stove. This stove dried the cores fairly quickly and did not use much fuel. It was fired at the bottom with smithy nuts, and this part had almost the appearance of a slow combustion stove.

To prevent the sand sticking to the boxes they rubbed talc powder (powdered soap stone) on them. This powder had a very slippery and smooth feel, and it kept the boxes in a smooth and clean condition.

Box Parts.

The box parts which were used by the ordinary moulders were the most antique ever seen. Both tops and bottoms had holes cast in the lugs and tapered pins were driven into the holes in the bottom parts to position the top parts. If the pin was too slack for the hole it was wrapped with paper and thus a great deal of time was wasted in pinning the boxes.

The boxes used by the machine moulders were in complete contrast to those just described. Usually they were about 12 in. × 20 in × 3½ in., and were of the loose pin type. Some of the boxes were bigger than this, but this is about the average size. These boxes were very light, and the loose pins were a very good fit, thus leaving the boxes free from twist.

The output from the ordinary moulders was not very good in spite of the fact that they were usually on piecework. This was probably due to bad box parts, and too tough a sand for quick work. This sand had to be worked very dry owing to the large amount of bond in it, and when the author was bench-moulding for a day or two he noticed that the sand which fell off the bench and piled up under his feet was so hard as to be difficult to dig away. Thus it required more ramming than British black sand, although it was a little easier to finish and mend up.

Floor-Sand Characteristics.

The floor sand used by the dummy moulders was not so strong, but even this required a lot of ramming. However, it was necessary to have a strong sand for their work, because their practice was to lift the mould from the plaster for both top and bottom parts. If the sand was weak parts of the mould would stop down. A great deal of the work done by the dummy moulders was cored, *e.g.*, electric joint-boxes, gas-burners, and grooved-pulleys. They also did stove and oven work. These types were easily made on the machines, which were of the hand-press type, and a man made about 50 to 60 boxes of these per day. On the other types of work, bad lifts were sometimes obtained, and since the sand had remained on the plaster and not on the mould it was difficult to mend them up, and they were usually knocked out. On this class of work a man made 40 to 50 boxes per day, coring and casting his own moulds.

In the morning the dummy moulders put the castings in the gangway and two girls took them away, putting the small ones in a shaker and the others on the dressing bench, where they afterwards brushed them off ready for the dresser.

All the metal for the cupola was raised by a hand-windlass and the weight was guessed when charging. The metal came down very hot and very clean, as the blow was not heavy, and the scrap was clean. It also came down very quickly, because the furnace had burnt out very big in the melting zone.

When casting there was no need for skimming for the metal was so clean, and a little sand sprinkled across it was all that was required. Care was taken not to cast the metal too hot, and thus the castings had a good skin, and, owing to the metal being very fluid and soft, very few short runs were to be seen.

The ladles in this foundry were daubed very thinly, and apparently they were not knocked out in a morning and redaubed, but, instead, just at the top of the ladle, where some of the daub had cracked off, a little fireclay was daubed round. These ladles were not daubed for over a week, though how long they were expected to last it is difficult to say.

Stove Grate Practice.

Another foundry which specialised in stove castings was visited. This concern was well laid out. The moulding machines were of the hand-press type and a track was provided for a wagon which supplied facing sand to the boxes by the machines. This facing sand was prepared in mills of the same type as the one previously described. These mills were supplied with new sand by chutes, and all the floor sand used for facing sand was first riddled with an electric gyratory riddle to remove all scrap. This riddle could be moved along the length of the shop on a runway, and thus the moulders probably riddled their floor sand in turns each morning. The pattern shop was almost entirely devoted to making plaster parts, usually with patterns fixed in each part, though some pattern filing was also done there. Very few cores were used in this foundry, and thus only a small core shop had been built. Some cores were being made with core gum as binder, and also others with oil sand. The dressing shop was equipped with two sets of double carborundum stones, and a sand blast of the rotary table type. From this department the castings were taken to the store.

In the foundry two men worked together—one made top parts and the other bottoms; thus the chance of dirty moulds was eliminated, and the castings were certainly very clean. The boxes were cramped before casting, and large steel cramps were used for this purpose, thus the floor was clear of weights.

British Cast Iron Research Association.—The January issue of the Association's Bulletin includes reports on Council and Committee activities and the annual general meeting, besides Papers on "The Photomicrography and Metallography of Graphite Flakes," "The Influence of Span on Transverse Rupture Stress," and "Recent Developments in Cast Iron and Foundry Practice," besides the usual "Abstract from Foundry Literature."

* A Paper read before the Burnley Section of the Institute of British Foundrymen.

Wood Patterns.*

Producers' and Users' View-points.

By F. C. EDWARDS.

The term "Wood Patterns" probably covered an immeasurably greater variety of objects than any other term in the English language. To examine but a tithe of those at present extant would call for a wide vision, and would occupy a lifetime.

View-points, too, differed considerably with various individuals. The mental picture created under the stimulus of a word, or object, depended upon many factors. Personal experience of the thing referred to naturally played an important rôle in the formation of the picture. If the experience happened to be a pleasant one, we should expect the individual to regard the thing differently—to differ in view-point—from another individual whose experience of the selfsame word or object happened to be unpleasant, but we should not be justified in attributing, without definite evidence, the pleasant experience of the one, nor the painful experience of the other, to any intrinsic virtue or vice in the thing itself. The capabilities of the individual for dealing with the thing, his likes and dislikes, all exercised some influence upon the nature of the experience, and as a consequence upon his point of view. The subject bristled with yet further complications. No two patterns, except in special circumstances, were alike, and two or more patterns producing similar castings might differ as chalk from cheese. Again, no two patternmakers had had the same experience, and, being human, were not likely to possess identical temperaments and capabilities. Moulders, likewise, differed in outlook, experience and capability. Finally, since wood patterns represented the patternmaker's means of existence, he might be pardoned, perhaps, if his point of view extended beyond the purely technical aspect into the domain of economics.

With such a bewildering infinity of variables it was not surprising to find that the patternmaker's point of view of wood patterns was more or less kaleidoscopic in character. According to the innate capacity and personal experience of the individual patternmaker through whose eyes they looked, the point of view might vary as the poles asunder. Those view-points might roughly be classified as "Realistic," and "Idealistic."

The "Realistic" View-point.

This features the common-or-garden patternmaker's view of wood patterns. Such a picture is only obtained with the greatest difficulty, for the energies of the average patternmaker are too completely absorbed in making wood patterns to permit him to speak entertainingly about them. Wood patterns had to be built, more or less laboriously, in thought-form in the brain of the patternmaker before they can appear as concrete things. Every step in the production of a properly constructed pattern, indeed, from the selection of the material to the arrangement of the rapping and withdrawal facilities, involves the exercise of creative thought. Here is an interesting condition of things. Since thought is invisible it naturally follows — unfortunately for the patternmaker—that the unseen work expended on the production of the average pattern far exceeds that which is visible to the ordinary eye, for the unseen—in this case at any rate—cannot be measured or weighed.

The realistic view-point contains another depressing feature. In no other branch of engineering —probably in no other industry—are the possibilities of going wrong so many and varied as in the making of wood patterns. Misinterpretation of printed or verbal ideas—sometimes of the haziest —may lead to disaster, faint blue prints in which the component and its dimensions are more or less undecipherable, imperfect pattern construction allowing warping or shrinkage of the pattern, misjudgment of contraction requirements of the metal, disagreement between corebox and pattern, mal-arrangement of pattern joints, inadequate bearing for cores, absence of locating features on core-prints. These are but a few of the possible delinquencies for which the patternmaker is held responsible. And in spite of the fact that many patterns are literally works of art, their creator is expected to produce them, on a strictly commercial basis. Finally, the demand for patterns is subject to very great fluctuations, and the patternmaker, even when his services are actually in demand, is everywhere regarded as a "necessary evil."

The "Idealistic" View-point.

But there is another way of regarding this subject, that is the idealistic view. Such a view makes the patternmaker a better man and the man a better patternmaker. Here is a clear recognition of the all-round educational benefits to be derived from the business of making wood patterns. (The term educational, by the way, is used in its original and true sense, namely, to draw out—to develop the innate capacity of the individual. One realises that in making wood patterns the training of hand and brain—historic partners in the development of latent intelligence —goes on continually.

Consider, for instance, how valuable is the mental and physical discipline incidental to the acquisition of an easy mastery over the patternmaker's common hand tools—saw and plane, chisel and gouge and the other diverse tools daily brought into use. Each calls for a certain knack of adjustment and manipulation peculiar to itself, each requires special guidance, and is operated with varying degrees of force.

The building up in the mind—often at a momentary glance—of the finished casting is quite a minor feat compared with the consideration of pattern construction and foundry requirements. Here the faculty of ratiocination—deductive reasoning—is intensively exercised. Appropriate data, culled from the field of experience and observation, referring to the behaviour of certain kinds of wood, employed with certain orientation of grain, under certain circumstances must be readily drawn upon by the patternmaker if he is to arrive in a reasonable time at the one best method of construction for the particular job on which he is at the moment engaged. If his pattern-making is to be worthy the name, he must arrange the grain of the wood, for instance, in such a manner as will eliminate the possibility of change in form or dimensions of the pattern as a whole, whether it is to be buried in moist sand for several days or hung up in the dry-pattern stores for as many years. As wood shrinks across the grain when subjected to heat, and swells under the influence of moisture the solving of these problems alone develops, as it progressively demands, the power of ingenuity.

Different sizes of the same type of pattern may call for radically different methods of treatment. Very small patterns, for instance, are usually best carved from a single piece of close-grained hard wood, such as lime or beech. On account of the liability of the wood to shrinkage and expansion the overall width or depth of such patterns should not exceed, say, 6 inches. The length is immaterial, as wood does not vary lengthwise of the grain. This method permits of the highest possible accuracy in setting-out the job. Moreover, the relationship of the several members to each other can be depended upon to remain constant. In carving these miniature patterns from the solid, also the ribs, bosses, hollows, etc., can be brought to a higher degree of neatness than if the projections were added extraneously.

The same type of pattern in a larger size would be more serviceable if composed of several pieces, the grain of each piece, of course, being arranged to the best advantage. In the case of a high-class standard pattern—that is one from which castings were continually being made—mahogany would be a very suitable material to employ, with brass facings to shield the more delicate parts from the remorseless stabbing of the moulder's vent wire. This brass reinforcement, by the way, is an excellent preservative of standard coreboxes. It is not an expense, but an investment.

A still larger member of the same type would probably be "framed up" or constructed in the nature of a skeleton. In this case one might use yellow pine almost exclusively. It is not so liable to warp out of shape, of course, as the hard woods, and is much easier to work up into the required shape. This type of pattern imposes more work on the moulder. The spaces in the frame, or skeleton, have to be strickled out and the corners of the mould must be rounded to leave fillets in the inside corners of the casting.

One finally arrives at a stage where a complete pattern is neither commercially feasible nor technically desirable. This is particularly the case with the heavy-weight cylindrical type of casting. Here the patternmaker has merely to supply the requisite strickle boards, with bosses, brackets, etc., to enable the moulder to "strike up" the mould in loam. Although whole patterns are not required, however, in this class of work, a more comprehensive knowledge of the moulder's requirements is generally called for than in the case of the smaller complete pattern.

Now most jobs, to the experienced eye, can immediately be placed in one or other of the above-mentioned categories. But there are borderline cases. These occasionally prove very tantalising —even to the competent patternmaker. The greater the experience, indeed, the more difficult it may be to arrive at a decision. More pros and cons emerge to be weighed one against the other.

Foundry Requirements.

Then there are foundry requirements. How best to mould the job—on its end or its side? Would the pattern be most serviceable made as one piece, or should it be jointed? Where should the joint, or joints, be situated? Where, if any, should cores be employed? Which form of core-print allows the safest and simplest anchorage of cores, and which, at the same time, does not complicate coremaking? And—remembering that the moulder, in assembling the job, has no blue print to guide him—how to eliminate the possibility of core misplacement? Remembering also that the pattern has to be withdrawn from the mould or the mould from the pattern (one of those familiar facts which proverbially breed contempt), what is the maximum taper permissible on the various members in the direction of withdrawal?

Now these questions, paradoxically enough, are easier to answer than to ask. Once they are brought to light by the patternmaker the appropriate solution is usually forthcoming. They are not apparent from the blue print. They cannot announce themselves. They await discovery. They must be sought for. Naturally, those that are not discovered are not answered. The pattern is to that extent imperfect; the moulder is handicapped; and efficient casting production becomes impossible. These questions do at times remain hidden until exposed to foundry conditions, when they crop up spontaneously. This is why fine examples of super-polished woodwork masquerading as patterns, are found wanting in the moulding shop; the supreme test reveals questions that want answering.

Here we see that the patternmaker does not live by wood alone. His recognition of the foregoing vital questions, it is no exaggeration to say, is simply and solely the reflex of his foundry knowledge. Essential to his success as a patternmaker though wood-working skill undoubtedly is, such skill must ever be subservient to the purpose and considered end of its employment. Skill, of whatever kind, if it is to bear good fruit, must be controlled by an ultimate, directive ability, and this power, in the case of the patternmaker, is attainable in one way only. He must become saturated with foundry knowledge.

* An abridgment of a Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. Longden presiding. The Author is on the staff of Messrs. W. & T. Avery, Limited, Soho Foundry, Birmingham.

Special Requirements.

The patternmaker has not only to locate questions on the blue print relating to foundry requirements, but he must answer them. Admittedly he may, especially if he is in immediate touch with the foundry, solicit the moulder's view on any definite point where his own data is insufficient. The method of moulding, for example, sometimes depends upon the foundry tackle available for the job. But special circumstances excepted, the patternmaker should early acquire the habit of deciding these questions "off his own bat." He will naturally make mistakes; but just as naturally he will profit from his mistakes. He will learn more from a few failures of his own than from many successes obtained by the help of others.

In the idealistic view, what do such decisions imply? If they are to stand the test of actual practice they mean that correct conclusions must be generally drawn from more or less incomplete premises. For it is seldom that a pattern is precisely like any previously made. Some special feature may call for a completely different method of treating the whole job than that employed with an otherwise identical pattern. It is here a case of "the little that may mean so much." And the detection of this little demands vigilance—an eye for detail—which keeps the faculties alert.

Machine shop requirements must also be borne in mind by the patternmaker. These, again, call at times for a nice discrimination. Where 1-32 in., or less, allowance, for instance, may be ample for a grinding operation on a small component, half an inch would not be excessive on the facings of a bed-plate likely to camber, nor 12 in. too much for a feeding head on a large cylinder. The requirements of machine shop and foundry sometimes conflict with each other. For instance, in arranging machined surfaces to mould downwards, as cast (where the cleanest metal gravitates), some moulding disadvantage may be encountered. It is invariably better to face this disadvantage in order to secure a better final result.

The idealistic view of wood patterns features yet another rôle, the filling of which makes the patternmaker's job especially interesting besides developing his power of initiative. He is situated, of course, between the drawing office and the foundry. He translates blue print instructions into terms of foundry practice. Now, just as the literal translation of one language into another may produce a crude or unmeaning result, so a strict adherence to blue-print instructions may similarly lead to an unworkable pattern, or to a scrap casting. Here freedom of expession—within legitimate limits, of course (that is, with the approval of the authority concerned), is essential to efficient production.

Freedom of expression calls for insight as well as initiative. Not only should the patternmaker be qualified to sense those blue-print requisites which are incompatible with good foundry practice—he must be capable of suggesting suitable alternatives. In his key position he can watch the interests of each for the benefit of both—not to mention that of the firm (the predominating partner) for which they all three work. Knowing their individual elastic limits, he can do much towards harmonising their respective requirements, and may thus play the part of a beneficent intermediary. Quite frequently, for instance, a slight alteration to the shape of a bracket or lug is found to eliminate the need for coring or to allow of greater simplicity in jointing the mould. Facings, etc., that according to the strict letter of the blue print, would require to be wired loosely on the pattern, might, by a minor modification, be made as part and parcel of the pattern.

The detection of such production handicaps in no sense implies shortcomings on the part of the draughtsman. It follows simply and naturally from the fact that the patternmaker, dealing, as he must do, at close quarters with the production details of the job, is brought face to face with difficulties which even the most accomplished draughtsman could never be expected to anticipate. The patternmaker must, of necessity, determine the construction of his pattern, locate joints, etc., before he actually commences to build it. The discovery of snags at this embryonic stage, therefore, saves the expense of subsequent pattern alteration—even if the job does not get into the foundry.

The Moulder's View-point.

The moulder, of course, is not called upon to take those flights of fancy incidental to the creation of wood patterns. He deals directly with the finished product. To him, the wood pattern is simply a tool for the production of castings. He is concerned neither with the history nor with the accuracy of the pattern. His judgment, moreover, is cruelly devoid of sentiment. If the pattern has been in use for a considerable period, indeed, the very faults that are complained of may be due to some improper treatment received whilst rendering service in an uncongenial environment.

The moulder's view, however, though cold and critical, is fairly consistent. There is a general agreement amongst moulders the world over as to what constitutes a good pattern. All moulders agree, for example, that a pattern should be sufficiently rigid to withstand ramming. A weak pattern is a treacherous one. The moulder cannot be expected to be constantly applying square, winding strips, etc., on the job as he is ramming it up. There are, of course, exceptions to the rigid-pattern rule. In the case of certain types of ribbed plates, for example, which are required to lie easily on a cambered, prepared bed, the limp pattern is preferable to the rigid one. The deep, "boxed-up" pattern, in particular, should be constructed in such a manner as to be proof against hard ramming. Many a pattern, in the past, which has entered the mould as a nicely-finished entity, has had to be dragged out, literally limb from limb, on account of its inability to withstand the remorseless pressure of ramming. There are some classes of work, however, where rigidity of pattern construction is out of the question. Though the patternmaker's ingenuity may be taxed to the utmost in the application of stopping-off pieces, the greatest care in ramming can alone secure a true casting. Here, if many castings, are required, wood patterns are out of place.

Probably the first thoughts of the moulder, as he looks over a new pattern, refer to the question of jointing. He cannot commence to mould the job, indeed, until he has arrived at a decision on the point. The more difficult the question, the less happy is his frame of mind, and, incidentally, the more does it usually point to incompetency on the part of the patternmaker. Deep jointing and drawbacks are not only very wasteful of moulder's time, but they invariably register their presence in a more or less unsightly manner on the casting. In these days of the oil-sand cores, they should seldom be resorted to. Where it is possible, also, cores should be arranged to take their bearing in the drag. This usually entails a little more work in the pattern-shop, but it is compensated for in simpler, and more accurate moulding.

The moulder likes to see the pattern arranged with as little as possible in the cope. When projecting members are unavoidable, however, he prefers them loosely dowelled to the pattern, to be lifted off with the cope as it is removed. These loose pieces, moreover, and loose pieces, in general, should be dowelled in such a manner as to eliminate the possibility of being wrongly positioned. This is a small matter to the patternmaker, but it may mean a great deal to the moulder. Perhaps the simplest method of dealing with this question is to employ dowels of differing diameters. Loose pieces, again, should be self-supporting, or nearly so, whilst they are being rammed up. On the sides of a job, as moulded, for instance, they should be held in position by generously tapered dovetails. For however careful the moulder may be with pieces positioned merely by nails or wired, there is always the risk of displacement as ramming proceeds after the removal of the nails.

Adequate core support is another prepossessing feature in a pattern from the moulder's point of view. Especially does he look for this support on the upper, as well as the lower side of the core as moulded. Core support, as every moulder knows, means something more than that supplied by a good, lower bearing surface as the core is laid in the mould. This is where the patternmaker occasionally goes astray. He forgets that the upward pressure of the core, as the metal fills the mould, is considerably greater than the gravity force exerted by the core, according to its weight, on the lower part of the mould. If, therefore, there is a difference in the area of core exposed in cope and drag respectively, it is generally better—other things being equal—to arrange the pattern so as to bring the greater bearing area in the cope.

Simplicity of core location is a further hall mark of good pattern-making from the moulder's point of view. What could be more annoying, for instance, than to find, after a core has been bolted securely to the top part (being filed down, perhaps, in places, to make it fit) that it is in the wrong position, or the wrong way round? This should never happen. The patternmaker has always the choice of several antidotes to combat such a possibility. A conspicuous corner removed here; an indentation there; or an especially generous taper on the core-print. These, and similar signs, will catch the moulder's eye *before* he places the core in the mould.

Obviously the moulder likes to see the pattern well tapered in the direction of withdrawal, and nicely filleted in the corners. True, the patternmaker cannot deviate very far from the blue print. The blue print, however, may sometimes be altered, and an altered dimension on a blue print does not look so bad as a torn-up mould in the foundry—and it certainly does not cost the firm so much! The author has long been convinced that a great deal more can generally be done for the moulder in the way of taper than is usually forthcoming. And this increased taper, moreover, would tend to enhance and not to impair the appearance of the finished casting. It can never be too strongly emphasised that a good mould left from the pattern is infinitely better than one that has had to be repaired.

With construction and moulding details satisfactory, a pattern should be nicely varnished if it is to command respect in the foundry. It must be given at least two coats of shellac varnish. This renders the grain of the wood impervious to moisture and imparts a smooth surface to the pattern. The colouring, of course, is immaterial, so long as the core-prints and the machined faces are indicated by distinctive colours. It is very convenient for the moulder, also, if those parts of the casting where the core cuts through, that is where no core prints appear, are painted clearly as cores.

The final "Open Sesame" in a wood pattern to the heart of the moulder is the provision of adequate rapping and lifting arrangements. Although the patternmaker may overlook this part of the job (as some of the best patternmakers occasionally do), the moulder must not blink the obvious fact that a mould cannot be filled with metal until the pattern is removed. He is perforce obliged to act upon the old Norse motto, "Either I will find a way or make one." Naturally he seeks the path of least resistance. This means that he looks for the most conspicuous joint in the pattern, namely, the joint most likely to give way under wedge pressure. Into the joint he inserts the point of a red-hot crow bar. A little later hefty sledge-hammer blows are rained, with seemingly malicious intent, on the crow bar from every point of the compass. If, at this stage, the patternmaker puts in an appearance, we might "listen-in" to something really worth hearing about wood patterns from the patternmaker's and the moulder's point of view.

Discussion.

Mr. J. S. Glen Primrose said the Paper was of interest not only to the foundryman and the patternmakers, but also to those whose duty it was to act as liaison officers between the two craftsmen, and advise what metal was most suitable for the purpose for which the finished article was required. He recounted a useful form of training, similar to what the old workers had to endure, and which was to-day obtainable in some science day schools. He referred to the same worker having to make his own design, then construct the pattern, make his own moulding tubs and boxes, and, finally cast from his own pattern, fettle the casting and analyse it to ascertain if its composition was correct. If such procedure was kept before the craftsman, the construction of patterns would often be very different, and the task of the foundryman much easier. He considered that the idealistic aspect put forward by the author was useful, but it often entailed a climb down to achieve the real; the transposition

might be painful, but the experience was often profitable in the long run.

MR. MACDERMOT: Would Mr. Edwards care to tell us which is the correct way to make wooden pattern-plates, varying in size from 14 in. to 3 ft., to be used by the ordinary hand-plate moulder and also what kind of wood would be the best to use?

MR. EDWARDS replied that he would "frame up" the plate. In a case of that kind he would not simply get a piece of material 14 in. or 2 ft., or whatever the size of the plate was, but he would frame it up in order to keep it absolutely true because of the possibility of shrinkage. Then the job would be put on and set out according to the drawing. Good mahogany, teak or pine would be suitable woods, but he preferred pine because it did not warp as easily as mahogany, which had to be perfectly dry before it could be used. Some 15 years ago he went into a certain workshop with the idea of taking charge. A large plate, 8 ft. by 7 ft., was being made in mahogany ¾ in. thick. Round the plate were ribs ¾ in. thick, and at various places were other ribs. One surface of the plate was a glued-up width of material in one direction and the other surface was a glued-up width of material in the opposite direction. The moment he saw the plate he knew it would be a failure because the mahogany, under the influence of moisture or heat, would warp, but being a newcomer in the shop he allowed it to go into the foundry. Two or three days after he was sent for. The plate had buckled to such an extent that it required six or seven half hundredweights to hold the corners down. With such weights on the corners it was not possible to ram satisfactorily, and as soon as the weights were taken off the corners rose up again. He constructed a new plate, which he described by means of a diagram on the blackboard.

MR. T. MAKEMSON remarked that Mr. Edwards had touched on most of the points a patternmaker ought to have in mind when working his craft, and in doing so had rendered a distinct service to the moulder. As the author pointed out, a pattern was not necessarily a work of art but rather a foundry tool, and if the patternmaker did not, so to speak, measure up the foundry requirements, no matter how well the pattern was made it would not be a success. Patternmakers who had not any foundry experience did not realise that, and if they could be persuaded to absorb some of the ideas Mr. Edwards put forward it would mean an easier time for the workers in the foundry. The mention of taper reminded him that on one occasion he was reproved by a moulder because there was too much taper on the patterns, his complaint being that "if all the patterns were tapered as well as you do them there would be no making up to do" and less work for the moulder. He (Mr. Makemson) did not think that ought to influence the patternmaker in framing up his pattern.

Another incident he remembered was when an apprentice made a pattern for a mould box He tapered the sides and the ends of the bars very carefully, but when he put it together he put the sides in upside down, with the result that the ends of the bars were tapered in one direction and the sides tapered in the other. Needless to say it was not a success.

The question of making cores so that they could not be put in the wrong way was very interesting. It was not always possible, but cores could be made reasonably "foolproof." They were indebted to Mr. Edwards for putting before them points which a good many people had in their minds and were not able to express them lucidly.

MR. SUTCLIFFE thought too much blame was put on the foreman moulder: he had to carry the burden of everybody including the drawing office and the pattern shop, and when he had produced his casting he was fetched into the machine shop.

He would like to ask whether Mr. Edwards put camber in the pattern and built it in, or did he suggest the moulder should do it by bending, as this sometimes was the cause of broken patterns. Mr. Sutcliffe drew several sketches on the blackboard and asked the author's view upon several points.

A MEMBER suggested that besides the moulding and patternmaking factors there was also the machine shop to be considered in the making of a casting. Economic production in the machine shop had to be studied and to give an abnormal amount of tapering meant excessive machining, especially with regard to the bushes and hubs.

MR. EDWARDS replied that it was perhaps best to consider the machinist before the moulder at times, because in the long run it was the machinist who had to decide whether a casting was going to be thrown out, and if it was thrown out the moulder's work was useless. He did not believe in overdoing the taper in the case of wheel bosses which had to be gripped in the lathe chuck.

The meeting then concluded.

Patterns for Steel Castings.

At the Glasgow symposium on steel castings one speaker remarked that co-operation was necessary between the designer and the founder, and that the third person to whom co-operation was most important was the independent patternmaker. He very correctly remarked on the great importance of this co-operation, as the patternmaker has to transform the engineer's wishes into something concrete for the foundryman to work upon, but if patterns are occasionally sent to foundries from which good castings cannot be made without much modification, as often as not it is the designer's fault, or owing to the patternmaker not knowing what tackle is available at the foundry. One foundry will insist on shell patterns, while another will, in normal times, refuse to make castings from other than block patterns with full coreboxes.

Foundry practice differs not only in different districts, but also to a great extent in each shop, and it is often extremely difficult for the independent patternmaker to know what kind of patterns will best suit the foundry's purpose. The independent patternmaker has another grievance in that foundries or engineering works will often force down his price, so that it is almost impossible for him to turn out satisfactory work. Thus an engineering firm can often obtain its patterns from an independent patternshop at less cost than if made in its own shop. The only way in which the outside patternshop can produce such cheap work is by employing boy labour. In fairness, be it said, that master patternshops, if they obtain a reasonable price, can turn out as satisfactory patterns and coreboxes as any patternshop connected with an engineering works, and that in nine cases out of ten the blame for unsatisfactory patterns should not be debited to the patternshop.

In times of depression foundries have to accept almost any kind of pattern, but some large steel foundries in periods of good trade refuse to work with skeleton patterns or coreboxes, and this is a reasonable attitude. Patterns for steel work have usually to withstand harder ramming than those for iron or brass, and should consequently be of stronger construction, and especially is this so if more than one casting is required. Rapid changes of section are not always avoidable, but they are often so. We have seen large steel valves very considerably modified at the patternmaker's suggestion in order to prevent unequal cooling, while strengthening ribs are of greater importance on steel than on iron castings. They often prevent the distortion of the casting during the cooling period, as well as assist the flow of the metal, even if they are not actually necessary as part of the design. In some works the drawing office very kindly assists the patternshop and foundry by marking machining allowances, but these are not strictly adhered to. In steel castings of moderate size it is quite common to leave ⅜ in. machining on some faces and not unusual for the moulder to add another ⅛ in. or more on top faces because of dirty metal.

Continental Contraction Allowances.

With regard to contraction allowances, the interesting statement was made, at the Glasgow meeting, that much greater contraction has to be allowed if patterns are going to Continental steel foundries. This certainly raises an interesting point. Perhaps in steel foundry work, more than in iron or brass work, there is no hard-and-fast rule with regard to contraction. The contraction rule may be satisfactory for small and even medium-sized work of what may be termed an ordinary kind, but for castings that are of great length and are perhaps so held that they cannot contract as much as allowed by a contraction rule, only experience enables the patternmaker to give the correct allowance. This certainly is the case with many large ship construction patterns, such as propeller-shaft brackets. The foundryman also has an important part to do in regard to the contraction and the possible warping of castings during cooling, by incorporating in the mould means of easing them immediately the metal has become set.

In addition to ribs that are left on the castings it is good practice to join up contiguous walls of metal with thin feathers. These are not always fitted by the patternmaker when the pattern is being made, but often to the moulder's specific instructions. These feathers, which may be ¼ in. thick, assist the flow of the metal and prevent the casting becoming warped, and they are cut away after the casting has cooled. The moulder may occasionally remove core-prints from patterns, but in most cases these are removed from top faces and to obviate the danger of a crush when lowering the cope on the drag. Occasionally cores may be omitted and hollow parts cast solid, but it is exceedingly difficult for the moulder to decide whether it is better to take the risk of producing "fuzzy" places or of displaced cores. Small cores, because of the searching nature of the metal, and for other reasons, are more troublesome in the steel foundry than in other foundries.

January Tin Statistics.

SUPPLIES.—Straits shipments, 8,394 tons; Australian shipments, 120 tons; Banka and Billiton shipments, 697 tons; Chinese shipments, 335 tons; standard arrivals in United Kingdom and U.S.A., 3,005 tons.

DELIVERIES.—U.K., 1,252 tons; U.S.A., 8,795 tons; Continent, 2,237 tons; other countries, 593 tons.

TOTAL VISIBLE SUPPLY.—Month's shipments, 9,546 tons; other afloat, 3,817 tons; total afloat, 13,363 tons; landing, 2,266 tons; in warehouse, 8,608 tons; total stocks, 10,874 tons; total visible supply, 24,237 tons.

UNITED KINGDOM.—Afloat from Straits, 710 tons; from Australia, 35 tons; from Batavia, 52 tons; from China, nil; landing (Straits and Australian), 120 tons; landing (other), nil; stocks of Straits and Australian, 774 tons; Banka and/or Billiton, 186 tons; other standard, 7,183 tons; total visible supply, 9,060 tons.

UNITED STATES OF AMERICA.—Afloat (all kinds), 9,196 tons; stock and landing, 2,611 tons.

CONTINENT, ETC.—Straits afloat, 2,514 tons; Banka and Billiton afloat, 856 tons; stocks in Holland, nil; total visible supply, 24,237 tons.

ARRIVALS OF BOLIVIAN TIN ORE, ETC., in terms of fine tin, 3,180 tons; Nigerian, 868 tons.

Sands for Oil-Sand Cores.

(*Continued from page* 125.)

ments have indicated that a grain size of 0.5 to 1 mm., frequently given as being suitable for silica sand for cores, is much too coarse. The grain size, with oil-sand cores, should not exceed 0.5 mm., and is best kept at 0.2 to 0.5 mm. The strength of the oil-sand cores is also very strongly influenced by the water content of the sand, and systematic experiments proved the value of the practice of drying the silica sand before mixing.

After drying well, the sand is moistened with a *definite* quantity of water, which it has been found from experience is best suited to the particular type of castings to be turned out. For every binding agent a definite drying temperature and drying period have to be adhered to, which again are best found by practical trial, and then that temperature always carefully maintained by the aid of thermometers. A simple and cheap machine has recently been placed upon the German market for moulding oil-sand cores on the compressed-air sand-throwing principle, a 33⅓ per cent. saving in core oil being claimed. The author illustrates some of the highly-complicated cores which have been made with this machine.

Foundry Costing.

The November meeting of the Sheffield Section of the Institute of British Foundrymen, held at the Albany Hotel, Sheffield, was unusually well attended, accounted for in some measure by the fact that accountants and others interested in Foundry Costs were specially invited to attend. The Branch-President, Mr. J. T. Goodwin, who was in the chair, expressed a great pleasure in seeing so many present, especially as it was the first lecture under his Presidency. He trusted that such an attendance would be equally kept up, if not more so, at the remainder of the lectures.

In introducing the lecturer, Mr. W. R. Wintle, Chief Cost Accountant, the Sheepbridge Coal & Iron Company, Limited, Mr. Goodwin pointed out that it was somewhat unusual to have a lecture of this nature, but in the capable hands of Mr Wintle, he was quite sure that the subject would be as interesting as was expected, and he was glad to see so many accountants present, who, he knew, would be anxious to put to Mr. Wintle a considerable number of questions at the end of his lecture and would avail themselves of this opportunity.

In order to meet present-day conditions the costs in the foundries and engineering shops were cut down to a minimum, and although jobs were rushed through the shops in order to cut down as much as possible standing charges, at the completion of the work it was almost usual to be told that a loss had been made. It was difficult to realise how such a thing could happen in face of the fact that the machines were driven to their utmost capacity and that all the staff had done their best, and in order to overcome these difficulties it was necessary to have a satisfactory cost system. He said by this he meant that not only should the system be satisfactory from the accountant's point of view, but also from the works' point of view.

"Foundry Costing" was the subject of Mr. Wintle's lecture, which, it may be mentioned, was the subject of the lecture given by Mr. Wintle at the Leicester conference, with some additional notes, and which has already appeared in THE FOUNDRY TRADE JOURNAL.*

THE PRESIDENT said they would agree with him that Mr. Wintle had covered the ground from A to Z of foundry costing. The thing he found now necessary to complete the system was a liaison officer between the cost office and the works in order to carry out the system more satisfactorily. He did not suggest that he should be an engineer, a moulder, a fettler and an expert accountant as well, but that he should realise the type of work done in each department on a certain job, and thus be able to impart to the cost office the essential figures. They would then appreciate that it was not altogether weight which was the basis of costing a job, but the time occupied on the floor of the foundry. Many firms had a fear of this because the figures given might be made public. This need not be if proper precautions were taken, especially as very few foundries are making the same class of castings, and even then, not under similar conditions.

Debiting Indirect Costs.

MR. C. L. MASON said he would like Mr. Wintle to enlarge a little upon his (Mr. Wintle's) standard costing. The most difficult things were the indirect charges, core-making, fettling, and, more or less, the weight of the casting.

MR. WINTLE said the whole question dealt with the job-cost system. The standard cost was the cost which they expected the casting to come out at in the foundry. Assuming they had bed-plates to cost, they had cost them at so much in times past, and in the course of a few years established their standard; these they re-estimated for that job, and expected the plates to come out somewhere within the limits they had obtained, in order to issue that standard to the foundry department. It was issued to the works as a guide and for the contract prices. That was not done to-day. Indirect charges were chiefly comprised of the labour in the foundry. The weight was the basis taken in debiting indirect charges. Core-making was a direct charge to the job itself, as was moulding.

MR. J. F. KAYSER said he could not understand how summary-costs could be used to estimate the price of production of castings.

MR. WINTLE took the questioner through a supposed estimate and said they could find the weight of the casting from the engineers. They would have to size up the type of work, and the wasters they might make would possibly be five per cent. That was a contingency that must be provided for. They were assuming that they were making one casting.

MR. KAYSER: Not a large number.

MR. WINTLE said they had to work the iron-cost out on the qualities they used. They find the iron at current price and allow for furnace losses. As to the cupola cost, it would be applicable to any casting made in the foundry. Coming to the moulding, they would get their estimate from the shop as to the cost of moulding and core-making. The moulding materials used would be by weight. In fettling they would have the cost per ton for each casting in the foundry, but probably not the one they were estimating for. They would estimate what rate per ton they would have to put in for the job. The overhead charges for moulding-shop, core-shop, fettling-shop, etc., were those usually ascertained in the monthly summary-cost, plus the general expense of the administration charges.

MR. KAYSER could not see how the costs could be found from the estimate before them. It was easy to get the cost of molten metal, but when it came to the moulding-shop he thought the best thing to do was to have the price per man. So far as the moulding was concerned they had to use their experience as to the length of time in moulding it. One of the most essential factors for a foundry manager to have was the cost of the men per hour.

MR. WINTLE said they would collect the times for each job from the shops, and they would take the actual material issued for the job. They placed before the manager the whole series of jobs taken into the foundry each week. There seemed to be a little confusion between the form used for estimation and that for costing. It did not appear to be appreciated that in the form before the members there was in a very concise way sufficient information to enable anyone to fix the overhead charges for any department of the foundry, and Mr. Kayser's suggested cost per head for each man was only another variation.

MR. W. H. VAUGHAN said the lecturer had put forward standard costs of six years back, but the speaker thought that in actual experience, owing to various circumstances, the costs were changing from day to day, so that the costs for to-day could not even be the standard for to-morrow. Costing was an approximation only at the best, and the wages one small element. Possibly the wages and material used were the only actual facts, the other constituents being approximations from previous experience. Would the lecturer visualise a shop where a casting occupying a considerable space, and in the pit dug, men and boys working side by side, and also in the same shop hand-moulding and machine-moulding served by one common crane? Would he tell them that this summary of costs would be applicable to a matter of that kind? Beyond any overhead purposes he felt he could not trust that method very far. Then, too, how were they going to adjust the annealing costs, where on the same bogie this week would be a "sprawling" casting weighing only a few tons and the next week the bogie would be loaded with castings weighing many more tons, but on both occasions the same time would be occupied in the furnace? He asked why the wages only had been adopted for the apportionment of overhead charges? The speaker felt that it was too narrow a basis, and suggested that a broader and better one was to take the manufacturing costs.

Did the lecturer in his accounts take any notice of wastage in the different stages of manufacture? Under the present depressed condition of trade where foundries were not working at anything like normal pressure to adopt standard costs based upon the actual experience of to-day would mean that fewer orders still would be obtained. Then what influence had tackle upon the actual costs? What was the lecturer's idea with regard to boxes and other foundry tackle? In some cases the speaker knew they were charged to revenue.

MR. WINTLE, replying, said that for very large jobs it was all a question for estimate. When a job remained in the shop for any length of time they were working at it nine times out of ten. There were, of course, exceptions where moulds had to wait for cores and drying. If they had a small job side by side with a large job they expected the wages to be somewhere in ratio.

(With this statement Mr. Vaughan disagreed.)

Establishment Charges.

MR. WINTLE, continuing, said the establishment charges of a foundry really represented services to every job in the place, and, in his opinion, must be distributed on the basis of time a job was in the foundry. He took wages as representing time in the majority of cases, and, therefore, distributed on the percentage basis of direct wages to establishment charges for the whole of the shop. He should allow every direct charge there was to be made according to the time spent on the job. He should get out three sets of establishment charges, moulding, coremaking and fettling, and apportion them on the basis of wages. This was not the Sheepbridge system, but a few ideas he had evolved. As to the standard cost he meant the normal standard cost under normal working conditions when trade was good. In depressed conditions of trade there were some charges they could and could not reasonably suspend. Rates and taxes had to be paid whether they worked or not, but the usual normal percentage should apply. As to the influence the tackle had on a large casting, much depended upon the floor space it was likely to occupy. They considered first of all whether it would be worth while making the tackle for the job. In nine cases out of ten if it was only a single job and likely to be intricate it was not worth while going in for the job unless one could get a fair price for the tackle cost. A careful watch had to be kept upon the moulding boxes. It was usual to charge these to revenue account through a depreciation account.

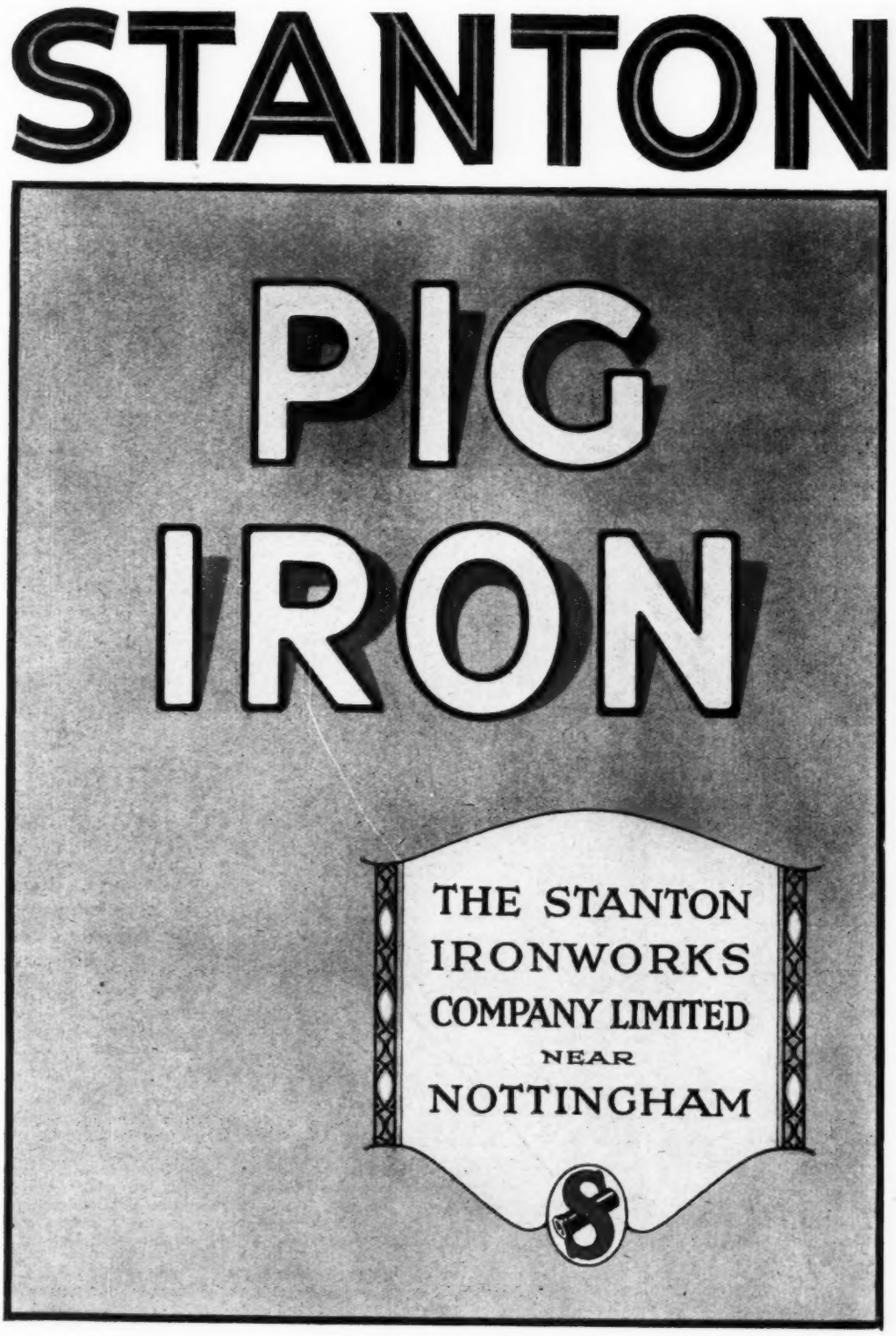
MR. VAUGHAN remarked that they had a practice whereby wages were kept separate, and all other shop and standing charges were applied by means of a shop-rate per hour.

THE HON. J. M. W. NORTH said he thought as far as standard charges were concerned, if the foundry knew that it had got to work a job for such and such an amount they might make it for that amount, but it would not always be the lowest price at which they could make it.

MR. F. A. MELMOTH said that a number of speakers had referred to the increased introduction of the cost-accountant into the foundry in such a manner as to suggest that a feeling of unwillingness to admit him existed in the minds of practical foundrymen. This was far from being the case, and, speaking for himself, he would not care to accept foundry responsibility without the assistance of a qualified cost-man. The foundry had become such a comparatively complicated business that it had found itself able to absorb, of recent years, men of varied training and qualifications. As an instance, he referred to the case of the metallurgist. His advent in the foundry was looked upon with some suspicion, and yet to-day he ventured to state that most foundries would find it difficult to get on without the aid of the metallurgist. The great value of the cost-accountant's work was that he enabled one accurately to compare the result of actually making the job, with the original estimate of it, which in many cases might be described as being in the nature of an intelligent guess, owing to the prominent effect of the human factor in heavy jobbing work.

The value of a lecture was often reflected in the discussion which it provoked, and, in proposing a very hearty vote of thanks to the lecturer, he (Mr. Melmoth) could safely say that the lecturer could congratulate himself on this point.

* See our issues of July 5 and 19, 1928.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Design of Engineering Castings in Relation to Tests.*

Mr. Hird thanked Mr. Pearce for his interesting Paper and asked whether it was a fact that in a test per square inch, any addition to the metal of the test bar reduced the strength in tons per square inch, and if Mr. Pearce knew of any case where half an inch had been added to a casting and it had been much weaker? He referred to a Paper he had heard at Leeds, the author of which said that when bulk had been taken out the casting had gained strength.

Mr. Pearce replied that he did not think the addition of metal actually weakened the structure, or that removing metal strengthened it in actual tons load, but, as Figs. 6 and 8 showed, an addition lowered the load carrying capacity in tons per square inch and a reduction increased it. Mr. McClelland asked if this would be more pronounced in a high silicon iron? Mr. Pearce said this was so, but beyond a certain point, when the metal cooled to ferrite and graphite, it could not get much weaker.

Mr. W. Sisson (Gloucester) expressed the delight of himself and his works manager, Mr. Pearson, at being invited to such a lecture by the Institute and their appreciation of the graphs showing: (1) The diminution of strength with increase of transverse dimension of test bar and the consequent necessity of making the test bar transverse dimensions fairly representative of the thicknesses of the casting with which it is associated, whether cast with it or separately cast of the same mixture; and (2) the diminution in strength with increase of total carbon plus silicon.

Mr. Sisson further expressed himself as in favour of the ordinary 1 in. × 1 in. test bar supports, but Mr. Pearce's authority on the side of the newly-arranged cylindric test-bars had caused some weakening in his objection to the change. The two main objections, he thought, were: (1) All were accustomed to this test-bar and had in their minds the "figures of merit" pertaining thereto. He admitted this was not very important, for all would soon become accustomed to the new "figures of merit." (2) A much more serious objection, to his mind, however, arose from the fact that it is, as he thought might be shown, much easier in a rectangular bar to collate the tensile and compressive strengths of cast iron with the Brinell number or some similar indication of hardness and compressive strength.

In common with most engineers, he supposed one always looked with some degree of scepticism on results of tensile tests in cast iron because of the difficulty of securing axial pull and of the serious effect of any slight unsymmetrical defect of the test piece. (It might be mentioned that Dr. Robertson, of the Merchant Venturers' College has a very ingenious ball and stirrup arrangement to secure axial pull.)

Why Modulus of Rupture Varies.

Referring to the great disparity in the ratio of the modulus of rupture to the tensile strength, as manifested in cast-iron beams of rectangular section and cylindric sections and in all materials where the compressive is much above the tensile strength, Mr. Sisson suggested this could be explained by considering that for transverse breaking the position of the neutral axis in such material could not ultimately pass through the centre of gravity of the section, but that it must shift largely towards the compression edge.

To illustrate this it was assumed that in a sample of cast iron the compressive stress was four times the tensile; then if it were assumed a beam of 3 in. deep under breaking load and that the neutral axis was 1 in. from the compression edge, and, therefore, 2 in. from the tensile edge, it would be observed that the geometrical of the two moments, tensile and compressive, would be 4:1, because on the tension side there was twice the section and twice the leverage.

In order to connect the tensile strength alone of the material with this beam, one must, said Mr. Sisson, take a beam double the 2 in. depth, that is 4 in. Squaring this one obtains 16 as a measure of transverse breaking strength. Reverting to the 3-in. beam above mentioned, and assuming its compressive strength equal to its tensile strength, the square of 3, 9, represents its transverse breaking strength, that is to say, in the actual material, the modulus of rupture is about 1.8 times the tensile. This, as pointed out by Mr. Pearce, is a fairly average ratio which the speaker could confirm. For example, a cylinder mixture—Lilleshall special cylinder, 2 parts; Warner C.B.R. 5, 1 part; Staveley No. 1, 1 part; returns or scrap cylinder mixture, 2 parts, gives Brinell number 255, tensile 17 tons; transverse on 1 in. × 1 in. × 12 fully 34 cwt., thus modulus of rupture (which, as would be remembered, is in such a beam 18 times the transverse breaking load) 31 tons, which is about 1.8 times the tensile.

Similar comparisons might be made in the case of different ratios of compressive and tensile strengths.

Influence of Section.

Mr. Sisson then suggested that it is not correct to speak of transverse breaking strength as so many do, this being the commonly called modulus of rupture, but that the term, modulus of rupture, should be retained.

In identically the same material the modulus of rupture would differ according to the section of the beam and was, therefore, not conditioned solely by physical property as a tensile strength is, but also by the shape of the section. As above, seen in a rectangular section, the modulus of rupture is about 1.8 times the tensile, but in a round beam the ratio would be higher and in a square beam placed diagonally it would be higher still, because of the concentration of material towards the middle of the beam and the consequent greater ultimate shift of the position of the neutral axis.

As above seen, the calculation of the probable shift of neutral axis is quite easy in the case of a rectangular beam, but is quite complicated in the case of a round beam.

Considering further, in the case of cast iron, the physical properties, tensile strength and Brinell number, and the geometrical-physical property of the section which we call the modulus of rupture, Mr. Sisson ventured to say that although, as Mr. Pearce pointed out, one could not expect to get very close relationships in such a complicated material as cast iron, and which is dependent on its treatment in the furnace, in the ladle and in the mould, yet it would appear that, given the tensile strength and the Brinell number, one could certainly say that the higher the Brinell number and, therefore, the higher the compressive strength, the higher would be the modulus of rupture for the same tensile strength, and, conversely, also given the modulus of rupture and the Brinell number, the higher the Brinell number the lower would be the tensile strength with the same modulus of rupture.

Author's Reply.

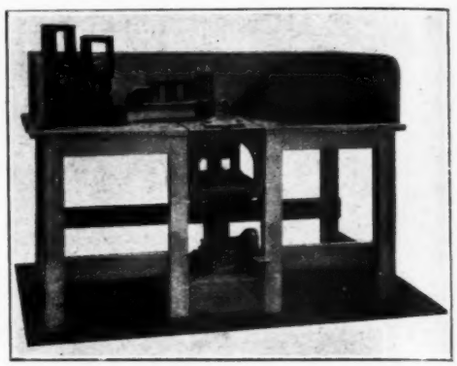
Mr. Pearce, replying to Mr. Sisson, said that he had listened to Mr. Sisson's remarks with great interest and appreciation. It was true that founders had some idea of what the 1 in. × 1 in. bar would stand. The trouble was that so many people used the 2 in. × 1 in. and the ½ in. × ½ in. bars, and each had a different "figure of merit." The working out of the rupture stress enabled everybody to speak in the same language. In any case the specification provided the "figure of merit" for round bars.

He had heard with admiration the ingenious argument developed by Mr. Sisson respecting the correlation of strengths of rectangular bars, but could not altogether agree, for, as a matter of fact, the ratio of 1.8 for transverse-tensile was equally true of round as of rectangular bars, and in the round bar the ratio of 16:9 could not hold. In fact, the 1.8 ratio was mainly based on round-bar tests, and it was most valuable to have Mr. Sisson's confirmation for rectangular bars.

* Discussion on the Paper, read before the South Wales and Monmouth Branch of the Institute of British Foundrymen, by Mr. J. G. Pearce, and published in our issue of January 24.

A Novel Foundry Tool.

During a brief inspection of the foundry of Messrs. The Westinghouse Brake & Saxby Signal Co., Ltd., of Chippenham, we were rather intrigued with a runner-bush making machine. This was being operated by a lad, who was turning out, without any special effort or preparation, seven to eight 4½-in. × 6½-in. runner bushes per min. The machine was centrally mounted on a neat core-making bench, the sand heap being stored on the right and the finished bushes on the left. Beneath the level of the bench is a former or plunger, and a space around this is filled with black sand. The runner bush is then placed in position against the stops on the bench. The head, clearly shown on our illustration, is swung



Coleman Runner Bush Machine.

forward until it engages under the hook. A foot-pedal opens a valve and allows compressed air at 100 lbs. per sq. in. pressure to operate the plunger, thus instantaneously forming the runner bush. We appreciated the cleanliness of the finished bush, which is probably more solidly compressed than those made by hand. Another point we discovered is that the machine will not function unless the swinging head is engaged under the hook: a factor which should make for safety. The machine was invented by Mr. Hodgson, who is on the staff of the Westinghouse Brake Foundry. The selling rights, however, have been acquired by the Coleman Foundry Equipment Company, Limited, of 1, Lancaster Place, Waterloo Bridge, London, W.C.2, whilst the plant will be known as the "Coleman Runner Bush Machine."

The Influence of Some Elements on the Growth of Cast Iron.

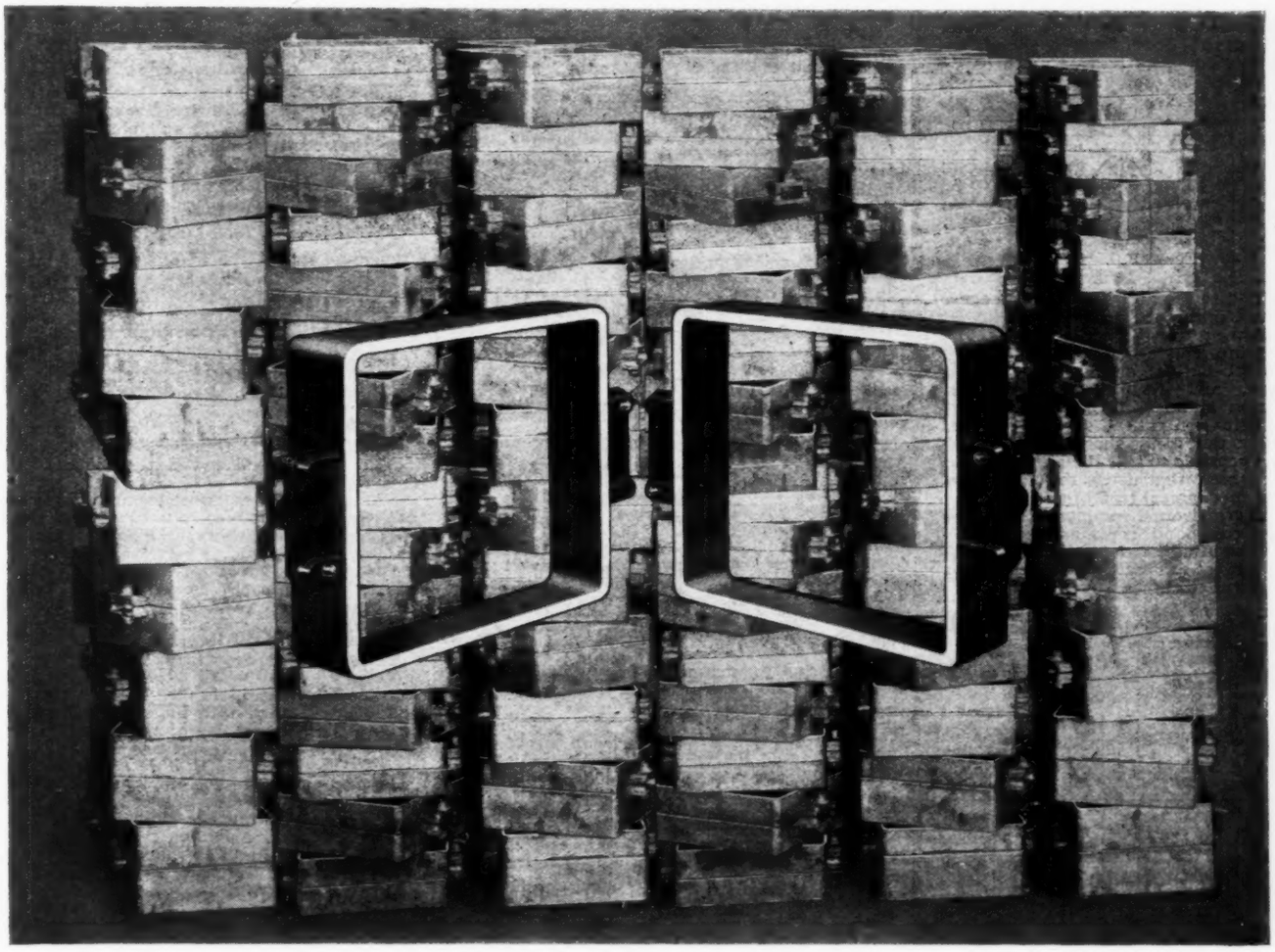
(*Continued from page* 122.)

ting-up of the carbide or deposition of carbon from the solid-solution) originates always at the places of least resistance, *i.e.*, mainly at the outer surface of the casting. If the structure of the interior of the metal is less dense the phenomenon may set in, simultaneously, in the interior: it then leads to characteristic zone formations and "growth" at different rates within the section of the casting.

6. The increase in volume due to this primary growth is not very appreciable; considerable loosening of the structure, however, results, and thus opens up the way to secondary growth due to corrosive and oxidising-agents acting from outside.

7. Efforts will thus have to be directed chiefly, in practice, to the production of a cast iron offering the greatest possible resistance to the primary splitting-up of the cementite and the separation of the carbon from the solid-solution. The silicon-content must accordingly be kept as low as possible and the manganese-content as high as possible. The total carbon-content is also best kept as low as possible, as generally, on freezing, the higher the total percentage of carbon, the coarser are the graphite-lamellæ, and these coarse graphite-lamellæ favour secondary growth by oxidation, corrosion, etc. Finally, the less porous the cast metal is the less surface will it offer to the attack of both primary and secondary growth.

CAST IRON BOXPARTS



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Students' Corner.

Q.—What is the general composition of foundry sands?

A.—The most common moulding sands are either red, terra-cotta, or various shades of yellow.

The following is an approximate composition of a common moulding sand, regardless of colour:

Composition.	Per cent.	Formula, etc.
Silica	80.00	SiO_2. Silicon Dioxide.
Alumina ..	9.09	Al_2O_3. Aluminium Oxide.
Ferric Oxide ..	3.50	Fe_2O_3. Iron. Ferric
Lime	0.50	$CaCO_3$. Calcium Carbonate.
Magnesia ..	2.25	Mg.O. Magnesium Oxide.
Alkalis	1.00	Soda and Potash.
Titanic Oxide	0.20	TiO_2. Titanic Acid.
Water	2.00	H_2O. (Combined).
Moisture ..	0.50	Air and Water.

In addition to the above, 2 to 3 per cent. organic matter may be present.

The following are the actual analyses of red moulding sands and yellow sands. They are sub-divided as strong, medium, and weak, and for convenience this classification is based upon bond content, not upon silica content. If such is correct, it is obvious that sands should be obtained as near as possible to suit the nature of the work—i.e., sand that needs the minimum amount of mechanical treatment.

It will be seen from the following analyses that the weak sand contains the least amount of bonding matter, and the strong sand the largest amount, and the medium comes in between these two.

Analysis of Yellow Moulding Sand.

	Strong; per cent.	Medium; per cent.	Weak; per cent.
Silica	80.5	83.10	88.30
Alumina ..	11.00	9.80	7.69
Ferric Oxide ..	3.20	2.70	2.54
Lime	1.20	1.04	0.72
Magnesia ..	1.08	0.71	0.58
Loss on ignition	2.38	2.03	0.92

Analysis of Red Moulding Sand.

	Strong; per cent.	Medium; per cent.	Weak; per cent.
Silica	78.70	81.90	85.30
Alumina ..	7.57	6.03	5.56
Ferric Oxide ..	2.23	2.34	2.51
Lime	2.70	0.40	0.80
Magnesia ..	1.73	1.24	0.46
Loss in calcination	5.05	1.84	1.62

The following gives both the chemical and mineral analysis of a sand from Pickering, Yorks:

Chemical Analysis.		*Mineral Composition.*	
	Per cent.		Per cent.
Silica	89	Quartz	79.31
Alumina	5.89	Felspathic Minerals..	8.53
Titania	0.20	Clay Substance ..	9.98
Ferric Oxide ..	1.94	Hyd. Iron Oxide	2.27
Lime	0.35	Other Constituents	0.17
Magnesia.. ..	0.17		
Potash	0.33		
Soda	0.57		

Chemical analysis gives exactly the total amounts of each constituent of the sand. Mineral analysis gives the combination of the various constituents. Chemical analysis does not show the total binding property of the sand, for some of it is in association in the formation of feldspar. Chemical analysis shows the total percentage of silica present which is only partially free in the form of quartz. All bonds, whether natural or artificial, belong to a class of bodies called colloids. These may be best observed when a small amount of sand has been well shaken in a clear glass bottle with clean tap water. The jelly-like substance separates out from the quartz and floats on top of the mass, and remains there permanently until the bottle is shaken again. The colloidal matter, or clay content, in the sample enables one to estimate roughly the amount of bond in the sand. With some of the Erith heavy strong bonded sands which

(Continued at foot of next column.)

Trade Talk.

It is reported that the Chattan Iron Works, Bonnybridge, are to be carried on under new ownership. A public announcement is expected shortly.

Messrs. Thos. W. Ward, Limited, have purchased from the Bombay Improvement Trust 16 standard-gauge locomotives of the saddle-tank type. They are to be brought to England.

The current issue of the London and North-Eastern Railway Company's magazine states that experimental sections of steel-sleepered track are to be laid down in all areas.

A message from Brisbane states that acceptance is recommended of a tender by Messrs. Babcock & Wilcox, Limited, to supply three boilers for Brisbane City Council's new power house at a cost of £74,266.

It is understood that the majority report of the Balfour Commission on British industry makes no definite recommendation in favour of the extension of the policy of safeguarding to the iron and steel trade.

Imports of foreign iron ore at the Prince of Wales dock, Workington, during January amounted to 6,100 tons, compared with 18,600 tons in December and 25,050 tons in January, 1928. During the month 2,100 tons of steel rails were shipped to Alexandria.

The influenza epidemic has been particularly marked in the Bonnybridge district. Most of the foundries have been able to maintain production at only 60 per cent. of capacity on the average, while many are carrying on with difficulty owing to depleted staffs.

It is announced that negotiations are proceeding for an amalgamation of interests between the Carron Company, the Falkirk Iron Company, Limited, and the Sinclair Iron Company, Limited. The Carron Company is a private concern, but the other two are public companies.

Ruths Steam Storage, Limited, have completed the formation and organisation of Ruths Steam Storage, Inc., New York, authorised capital $1,500,000, and of Ruths Steam Storage (Canada), Limited, with an authorised capital of $300,000, to operate the Ruths patents in the United States and Canada respectively.

At a recent meeting of the firm of Messrs. Haslam & Newton, Limited, Derby, the chairman, Mr. J. H. Lard, J.P., said that the company was anticipating a period of brisk trade. The Haslam branch had entered into a contract for a period of years to supply a minimum of 100 complete refrigerator units per week, and, with the Newton side of the business, had arranged several contracts for artificial silk and acetate plants.

The first annual dinner of the East Midlands Branch of the Institute of Mechanical Engineers was held at Nottingham on February 2. Dr. H. Schofield (Principal of the Loughborough College) presided, and was supported by the Lord Mayor of Nottingham (Ald. A. R. Atkey) and the Mayoress (Mrs. Atkey), the Lord Mayor and Lady Mayoress of Leicester (Ald. H. and Mrs. Hand), Sir Henry Fowler (chief mechanical engineer, L.M.S., Derby), Ald. E. Huntsman, and Brig.-General M. Mowat (Secretary of the Institute).

The Grinding and Pulverising Offices of International Combustion, Limited, 11, Southampton Row, London, W.C.1, report that new orders have been received for the following equipment:—For England: One 6 ft. by 36 in. Hardinge ball mill, for wet coal grinding; one Raymond pulveriser, for grinding colours; one Raymond pulveriser, for grinding copper oxide; and one 3-roller Raymond mill, for grinding ochre. For India: One 3-roller Raymond mill, for grinding oxide. For Germany: One 4 ft. by 5 ft. 2-surface Hummer electric screen, for screening slag. For Holland: One 5-roller Raymond mill, for grinding phosphate. For Italy: One cage mill and one 3-roller Raymond mill, for grinding phosphate. For France: One 3-roller Raymond mill, for grinding phosphate, and one Hardinge ball mill, with separators, for grinding graphite.

Students' Corner.

(Continued from previous column.)

are yellow in colour even the bonding, or colloidal matter from oxide of iron, and oxide of aluminium can be distinguished.

The bonding materials usually found in moulding sands are known as suspension colloids. If the water is in sufficient excess, say, 100 times the weight of the sand, often these minute particles of colloidal matter will remain in suspension for a long time. The various colloids which constitute the bond values, which neither analysis, chemical or mineral, nor water-test, can give definite information, and the notion of the colloids being complex, renders the study of their component parts difficult.

Contracts Open.

Birkenhead, February 19.—Wrought-iron and steel bars and charcoal sheets; iron, brass and gunmetal castings, for the Corporation. The General Manager, Corporation Tramways and Motors, Laird Street, Birkenhead.

Bolton, February 23.—Cast-iron surface boxes, etc., for the Town Council. The Waterworks Engineer, St. George's Street, Bolton.

London, E.C., February 19.—Dogspikes, steel boiler and flue tubes, axles, tyres and buffers, for the Bengal and North-Western Railway Company, Limited, 237, Gresham House, Old Broad Street, London, E.C. (Fee 10s., non-returnable.)

Southport, February 20.—460 tons of cast-iron spigot and socket pipes and specials, 18 in. diam., for the Southport, Birkdale and West Lancashire Water Board. Mr. C. Burton Ede, engineer and manager, 14, Portland Street, Southport.

Sydney, N.S.W., March 22.—Structural bridgework, for the Main Roads Board of New South Wales. The Department of Overseas Trade. (Reference A.X. 7453.)

Obituary.

Sir John Cowan, head of the engineering firm of Redpath, Brown & Company, Limited, Edinburgh, Manchester and London, died in Edinburgh last week, aged 84.

Mr. James Davis, who for over 35 years was manager of the rolling mills of Messrs. Spencer & Sons, at Newburn-on-Tyne, died recently at his residence in Gosforth.

The death has occurred of Mr. A. Keetley, who was for a long number of years manager of Messrs. Eastwood, Swingler & Company, of Derby. He was 72 years of age, and was one of the most highly respected men in the industry.

As already announced, the death has occurred of Mr. John P. Kinghorn, who was well known in iron, steel and shipping circles in the Clyde district. Mr. Kinghorn had been connected with the iron trade all his life. Originally in the employ of the famous ironmasters, Messrs. William Dixon, Limited, Glasgow, he started business in partnership with Mr. William B. Cowan in 1878 as importers of iron ore, iron brokers, iron, steel and coal exporters and merchants. Mr. Kinghorn took an active interest in public affairs. He was a harbour ratepayers' representative on the Clyde Trust, representing specially the iron and shipping trades. He was also an active member of the Chamber of Commerce in Glasgow, and a Justice of the Peace for the city.

The death is announced of Mr. T. W. Alsop, a director of the Falkirk Iron Company, after a prolonged illness. Mr. Alsop went to Falkirk as a boy, was educated there, and thereafter started his life's work with the Falkirk Iron Company, Limited, in whose service he eventually attained to the position of head of the company in London. He retired from active service a few years ago, but still retained his seat as a director, and attended the board meetings regularly so long as failing health permitted. He was one of the most prominent and best known men in the light ironfoundry industry, not only in this country, but abroad, and his passing will be regretted by his many business and other friends. Mrs. Alsop died three years ago, and there is no family.

Mr. James Richardson, B.Sc., chief of the engineering and technical staff at the Naval Construction Works, Dalmuir, of Messrs. William Beardmore & Company, Limited, died on February 6, in Glasgow. Mr. Richardson was a specialist in internal-combustion engine design and construction, and contributed Papers on the subject to many technical societies. He had just completed a term of office as chairman of the Glasgow section of the Institution of Mechanical Engineers, and it was in that capacity that he presided over the series of joint meetings of the Mechanical Engineers and Foundrymen for the discussion of steel castings recently. Mr. Richardson took a great interest in foundry work, and was a frequent visitor to the Scottish Branch meetings of the I.B.F. He was mainly responsible for the cordial relations and the institution of the joint meetings between the Scottish sections of the two Institutes.

Mr. F. W. Morgan and Mr. L. J. Wolf have acquired the shares and other interests in the business carried on by Wagner Electric Supplies, Limited, at 66, Victoria Street, London, S.W.1, and the name of the company has been changed to Wolf & Morgan, Limited.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Although necessarily slow, expansion of demand for Cleveland iron continues steadily, and this not alone in supplying the more exacting needs of the local steelworks, but also to an increasing extent infilling requirements of an improving demand for foundry consumption. Progress in the latter direction has been stimulated this week by the termination of the labour troubles in connection with the wages dispute in the light castings branch, whilst there is a perceptible quickening of activity at the heavy foundries, where an increased consumption of pig-iron has already developed. In the export trade, too, there is a little more inquiry, but in this direction improvement is slow, and exports consist chiefly of hematites and special qualities of iron. With regard to export business, it is significant to note that the shipments of pig-iron from the Tees rose from 15,812 tons in December to 18,851 tons in January. Coastwise shipments reached 8,238 tons, as against 6,479 tons, and foreign cargoes 10,613 tons, as against 9,333 tons. An alteration has been made in prices, which are now 1s. higher at the following levels, for both home and export transactions :—No. 1 Cleveland foundry iron, 69s. 6d. ; No. 3 G.M.B., 67s. ; No. 4 foundry, 66s. ; No. 4 forge, 65s. 6d. per ton.

As previously reported, the North-East Coast hematite section of the industry continues to develop on satisfactory lines, both as regards home and export business, a better demand on Continental account being a noteworthy feature of late. Meanwhile, as prices barely cover cost, the makers have seized the opportunity to advance quotations to the extent of 6d. per ton. Thus 72s. per ton has become the minimum for East Coast mixed numbers, whilst for No. 1 72s. 6d. is now quoted. On the North-West Coast Bessemer mixed numbers are quoted at 70s. 6d. per ton at works.

LANCASHIRE.—The gradual improvement in the foundry trade position in this area is reflected in a rather better demand by consumers than has been in evidence recently, and even some forward business is recorded in the local markets. Current quotations continue firm, with Derbyshire No. 3 from 69s. to 71s. per ton, Staffordshire up to 72s. 6d., and Scottish 88s. to 90s. per ton, all delivered Manchester or equal.

THE MIDLANDS.—It is satisfactory to state that some slight improvement in demand can be noted in certain sections of the consuming industries in the Black Country districts, but so far demands for foundry pig remain slow and still indefinite in outlook. As regards price fluctuations, certain Derbyshire furnaces are quoting 62s. 6d. per ton, while others are selling at 61s. Northants. iron is supposed to be at 57s. 6d. f.o.t. furnaces, but is obtainable at 6d. below this. North Staffordshire furnaces have not moved from the figure of 65s. f.o.t.

SCOTLAND.—The new arrangement with regard to prices for Scotch foundry iron is causing a considerable amount of discussion, and there is also some criticism of lack of information as to the actual position, which appears to be confusing. In the meantime, the current quotation for No. 3 Scottish iron is 71s. The dispute with the rain-water pipe moulders has been settled, but the trouble with the malleable workers is still under discussion, though it is hoped that a settlement will be reached before long.

Metals.

Copper.—An outstanding feature of the base metals markets of late has been an almost unprecedented strength in warrant copper values, which has during the past few months advanced values to record levels, practically unchecked in steady persistency. Some unimportant change was, however, observable towards the week's close, but, as reports of consumptive demand at home and abroad continue favourable, there are at present few, if any, signs of a weakening of buying interest in the immediate future. The reports of the proposed advance in the wages of copper miners lend support to the belief, expressed in some quarters, that values will be still further advanced.

Closing quotations are :—

Cash.—Thursday, £78 5s. to £78 15s. ; Friday, £78 2s. 6d. to £78 5s. ; Monday, £77 to £77 2s. 6d. ; Tuesday, £76 8s. 9d. to £76 11s. 3d. Wednesday, £76 7s. 6d. to £76 8s. 9d.

Three Months.—Thursday, £77 15s. to £77 17s. 6d. ; Friday, £77 18s. 9d. to £78 ; Monday, £77 7s. 6d. to £77 8s. 9d. ; Tuesday, £77 to £77 2s. 6d. ; Wednesday, £77 to £77 1s. 6d.

Tin.—The market for standard tin is also inclined to increased strength, and recently increasing buying interest has been strongly in evidence. After a period of almost complete inactivity, save some effort to keep the price above £220, fresh support has been given to the market, which, together with bear covering, has caused the great increase in strength which materialised at the close of the week.

Official closing prices :—

Cash.—Thursday, £225 10s. to £225 15s. ; Friday, £224 to £224 5s. Monday, £224 7s. 6d. to £224 12s. 6d. ; Tuesday, £224 15s. to £224 17s. 6d. ; Wednesday, £224 10s. to £224 12s. 6d.

Three Months.—Thursday, £226 5s. to £226 10s. ; Friday, £224 10s. to £224 15s. ; Monday, £225 10s. to £225 12s. 6d. ; Tuesday, £225 5s. to £225 10s. ; Wednesday, £225 to £225 5s.

Spelter.—Consistent steadiness still continues the prevailing feature of the spelter market, taking the situation as a whole, although the many rumours in circulation regarding the results of the deliberations of the Cartel have caused a somewhat nervous tone. Consumptive demand in this country has been dull, and Continental advices report quiet conditions prevailing there.

Daily quotations are :—

Ordinary.—Thursday, £26 6s. 3d. ; Friday, £26 6s. 3d. ; Monday, £26 2s. 6d. ; Tuesday, £26 2s. 6d. ; Wednesday, £26 2s. 6d.

Lead.—The tendency of the market for foreign pig has been mainly steady, but business on the Continent has been rather quieter than of late. Towards the close of the week an increase in the demand from consumers caused a revival of interest in this country, but the future of this metal is not assured, and the market is bound to be somewhat unsteady.

Prices have been :—

Soft Foreign Prompt.—Thursday, £23 ; Friday, £23 2s. 6d. ; Monday, £23 7s. 6d. ; Tuesday, £23 6s. 3d. ; Wednesday, £22 17s. 6d.

(*Small Advertisements continued from Page* 18.)

TENDER.

FOR SALE BY PUBLIC TENDER.

THE FOUNDRY and ENGINEERING BUSINESS of ALFRED DANKS, LIMITED, FREEHOLD Premises, VALUABLE PLANT, MACHINERY, etc.

The whole business will be sold as a Going Concern. The Company's premises are FREEHOLD and comprise :—

(1) The "EMLYN WORKS," GLOUCESTER, containing an area of about 16,400 SQUARE YARDS (of which about 89,500 square feet are covered by Buildings), including MALLEABLE IRON FOUNDRY and GREY IRON FOUNDRY, each with modern buildings permitting of present output of 40 tons and 60-80 tons per week respectively, and capable of considerable expansion.

MODERN FOUNDRY PLANT :

EXCELLENT GENERAL OFFICES fitted with low-pressure hot-water system.

ELECTRIC LIGHT and POWER is fitted throughout the Buildings and Works.

The whole is conveniently situated close to Gloucester Station (G.W.R.), with AMPLE SIDING ACCOMMODATION connected to two Railways.

(2) The "WESTGATE IRON WORKS," The Quay, GLOUCESTER, including PLANT AND FITTINGS, and comprising commodious offices and well-lighted Engineering Shops.

Inspection at any time up to 28th February.

FULL particulars with Conditions of Sale, Forms of Tender, and permit to view, may be had, on application, from J. H. Baker, Esq., Chartered Accountant, King Street, Gloucester, or Messrs. Taynton & Sons, Solicitors, Gloucester.

PROPERTY.

11 ACRES WORKS SITE,
SHEFFIELD.
145,000 Sq. Ft. of SHOPPING,
Compact and Convenient.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers, or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

FOUNDRY.—For Sale, Titan Foundry, Dumballs Road, Cardiff, as a going concern.—For particulars apply E. S. Foden, Chartered Accountant, 16, Merchants Exchange, Cardiff.

SALE BY PRIVATE TREATY.

TRAFFORD PARK, MANCHESTER.

For Sale by Private Treaty at a bargain price.

MODERN FOUNDRY—ERECTED 1921, with Railway Sidings into Works. Excellent Warehouse and Packing Room and fine Suite of Offices. Area of land 7,173 sq. yds., of which 2,850 are covered by a one-storey erection on same level. Easily adaptable for other trades.

To treat : F. S. Airey, Entwistle & Company, 10, Norfolk Street, Manchester.

FOUNDRY REQUISITES

Try our REFRACTORIES.

Ganister or Silica Bricks and Blocks (any shape or size) **Sands, Cements, Ganister.**—*Let us have your enquiries*

THE
CLEVELAND MAGNESITE & REFRACTORY CO., LTD.
Normanby Brickworks, Normanby, Eston, Yorks

Bailey's AIR COMPRESSORS
STEAM, BELT, or ELECTRIC.
Two-Stage Compression in One Cylinder.
HIGHEST EFFICIENCY MAINTAINED
AFTER YEARS OF WORK!
In many sizes to 3,000 cubic ft. per min.
SIR W. H. BAILEY & Co., Ltd., MANCHESTER.

FOSTER BROS. (LIMITED) WEDNESBURY.
TELEPHONE Nos
TELEGRAMS: "FOSTERS, WEDNESBURY."

M
SCOLS
R
TRADE MARK

IRON & STEEL CEMENTS

AWARDED DIPLOMAS and MEDALS by the ROYAL SANITARY INSTITUTE, LONDON.

3 GRADES

ALL BRITISH CEMENTS

A
WHITE LABEL
B
BLUE LABEL
C
RED LABEL

Full particulars upon request.

Sole Manufacturers—
MAJOR, ROBINSON & Co. Ltd.
385 & 387, CITY RD., CORNBROOK,
MANCHESTER.
'Phone: Trafford Pk. 1760 Telegrams: "Blowpipe, Manchester."

BRADLEY FACTS FOR FOUNDRYMEN No. 3

PRICE

In buying Pig Iron, quality is of first importance—price comes next.

Bradley's specialise in quality irons and although the prices are the cheapest in their grade, Bradley's do not profess to offer the illusionary "something for nothing."

THE CHEAPEST IRON IS THE ONE WHICH BEST SUITS YOUR PURPOSE

It is false economy to buy an iron supply because the price is low. Just think, what enormous losses occur in foundries through unsuitable metal.

Bradley's REFINED
PIG IRON

"A QUALITY FOR EVERY REQUIREMENT"

BRADLEY & FOSTER, LIMITED
DARLASTON, STAFFS.
And at Capponfield, Bilston.
TELEPHONE: DARLASTON, 16. (Private Branch Exchange) *TELEGRAMS: BRADLEY'S, DARLASTON.*

ARE YOU TROUBLED WITH GASES FROM YOUR CORES?
IF SO, REMOVE THIS TROUBLE BY USING

BRITAIN'S CORE BINDER
"CUMMINGUM"

A BINDING PROPOSITION THAT IS A PLEASURE TO USE, GIVES GREATER PRODUCTION WITH EFFICIENCY, SAVES TIME, WORRY, MONEY, AND, LASTLY, GIVES OFF NO OBNOXIOUS FUMES.

Wm. Cumming & Co., Ltd.

Glasgow - Falkirk - Chesterfield - Deepfields - Middlesbrough

Always at your Service. *Send for Sample.* *Stocks at all Branches.*

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	76 7 6
Three months	77 0 0
Electrolytic	83 10 0
Tough	81 0 0
Best selected	81 10 0
Sheets	108 0 0
India	94 0 0
Wire bars	84 6 3
Do. February	84 6 3
Do. March	84 6 3
Ingot bars	84 6 3
H.C. Wire rods	85 10 0
Off. av. cash, January	75 11 11 19/40
Do. 3 mths., January	73 14 10 15/16
Do., Sttlmnt., January	75 12 1 19/41
Do., Electro, January	78 17 0 5/7
Do., B.S., January	77 12 6
Aver. spot price, copper, Jan.	75 11 11 19/32
Do. Wire bars, January	79 2 0 5/7
Solid drawn tubes	15d.
Brazed tubes	15d.
Wire	10½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	11⅞d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	11½d.
Wire	10⅞d.
Rolled metal	10⅝d
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	224 10 0
Three months	225 0 0
English	224 15 0
Bars	226 15 0
Straits	231 15 0
Australian	—
Eastern	224 15 0
Banca	237 5 0
Off. av. cash, January	222 16 3
Do., 3 mths., January	222 14 1 17/20
Do., Sttlmt., January	222 15 10 19/20
Aver. spot, January	222 16 3

SPELTER.

	£ s. d.
Ordinary	26 2 6
Remelted	25 0 0
Hard	20 0 0
Electro 99.9	29 5 0
English	26 10 0
India	21 10 0
Zinc dust	(Nom.) 36 10 0
Zinc ashes	8 5 0
Off. aver., January	26 4 3 1/5
Aver., spot, January	26 3 11 3/32

LEAD.

	£ s. d.
Soft foreign ppt.	22 17 6
English	24 10 0
Off. average, January	22 4 6 5/11
Average spot, January	22 2 2 13/32

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	34 0 0
Do. V.M. ex whf.	33 5 0
Rods	44 0 0
Boiler plates	32 0 0
Battery plates	32 15 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	54 10 0
Chinese	38 5 0
Crude	33 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 3 9

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	7 17 6
45/50%	12 0 0
75%	19 10 0
Ferro-vanadium—	
35/50%	13/9 lb. Va.
Ferro-molybdenum—	
70/75% c. free	3/9 lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%	£18 0 0
Ferro-tungsten—	
80/85%, c. fr.	1/6 lb.
Tungsten metal powder—	
98/99%	1/10½ lb.
Ferro-chrome—	
2/4% car.	£30 15 0
4/6% car.	£21 15 0
6/8% car.	£20 17 6
8/10% car.	£20 10 0
Ferro-chrome—	
Max. 2% car.	£33 5 0
Max. 1% car.	£36 0 0
Max. 0.70% car.	£44 0 0
70% carbonless	1/- lb.
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/- lb.
Aluminium 98 99%	£95 0 0
Metallic chromium—	
96/98%	2/6 lb.
Ferro-manganese (net)—	
76/80% loose	£13 15 0
76/80% packed	£14 15 0
76/80%, export	£14 10 0
Metallic manganese—	
94/96%, carbonless	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.
South Wales—	
Hvy. steel	3 10 6
Bundled steel and shrngs.	3 5 0 to 3 10 0
Mixed iron and steel	3 5 0
Heavy cast iron	2 18 6 to 3 0 0
Good machinery for foundries	3 0 0 to 3 2 6
Cleveland—	
Heavy steel	3 2 6
Steel turnings	2 12 6
Cast iron borings	2 5 6
Heavy forge	3 10 0
W.I. piling scrap	3 5 6
Cast-iron scrap	3 2 0 to 3 5 0
Lancashire—	
Cast-iron scrap	2 12 6 to 3 5 0
Hvy. wrought	3 11 6
Steel turnings	2 8 6
Scotland—	
Heavy steel	3 7 6
Cast-iron borings	2 12 6
Wrought-iron piling	3 7 6
Heavy machinery	3 8 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	57 0 0
Brass	39 0 0
Lead (less usual draft)	19 0 0
Tea lead	16 0 0
Zinc	16 10 0
New aluminium cuttings	67 0 0
Braziery copper	52 0 0
Gunmetal	55 0 0
Hollow pewter	150 0 0
Shaped black pewter	105 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	69/6
Foundry No. 3	67/-
Foundry No. 4	66/-
Forge No. 4	65/6
Hematite No. 1	72/6
Hematite M/Nos.	72/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/-
,, d/d Birm.	85/6
Midlands—	
Staffs. common*	72/6
,, No. 4 forge	60/-
,, No. 3 fdry.	65/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/-
,, fdry. No. 3	57/6
Derbyshire forge	59/-
,, fdry. No. 3	60/-
,, basic	65/-
Scotland—	
Foundry No. 1	76/-
,, No. 3	71/-
Hem. M/Nos.	75/-
Sheffield (d/d district)—	
Derby forge	61/6
,, fdry. No. 3	64/-
Lincs. forge	62/6
,, fdry. No. 3	65/6
E.C. hematite	80/-
W.C. hematite	83/6
Lincs. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	61/-
Basic	61/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	69/- to 71/-
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	88/- to 90/-
Glengarnock, No. 3	88/- to 90/-
Gartsherrie, No. 3	88/- to 90/-
Monkland, No. 3	88/- to 90/-
Shotts, No. 3	88/- to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.) nom.	10 5 0	
Nut and bolt iron	8 10 0 to 8 15 0	
Hoops	11 10 0	
Marked bars (Staffs.) f.o.t.	12 0 0	
Gas strip	11 10 0	
Bolts and nuts, ½ in. × 4 in.	15 5 0	
Steel—		
Ship plates	8 7 6 to 8 12 6	
Boiler plts.	10 10 0	
Chequer plts.	10 12 6	
Angles	7 17 6	
Tees	8 17 6	
Joists	7 17 6	
Rounds and squares, 3 in. to 5½ in.	8 17 6	
Rounds under 3 in. to ⅜ in. (Untested)	7 15 0	and upwards
Flats, over 5 in. wide and up	8 7 6	
Flats, 5 in. to 1½ in.	7 17 6	
Rails, heavy	8 10 0	
Fishplates	12 10 0	
Hoops (Staffs.)	10 10 0	
Black sheets, 24g.	10 0 0 to 10 10 0	
Galv.cor.shts.,24g.	13 10 0 to 13 15 0	
Galv. fencing wire 8g. plain	12 10 0	
Billets, soft	6 5 0 to 6 12 6	
Billets, hard	7 7 6 to 7 15 0	
Sheet bars	6 0 0	
Tin bars	6 0 0	

PHOSPHOR BRONZE.

	Per lb. basis
Strip	1 3½
Sheet to 10 w.g.	1 3½
Wire	1 5½
Rods	3½
Tubes	1 9
Castings	1 2½

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.00
No. 2 foundry, Birm.	16.50
Basic	19.26
Bessemer	20.79
Malleable	20.01
Grey forge	19.26
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.60
Sheets, blue an'l'd, 9 and 10	2.10
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.30
Tinplates, 100 lb. box	$5.35

COKE (at ovens)

Welsh foundry	26/- to 36/-
,, furnace	20/- to 25/-
Durham and North.	
,, foundry	16/-
,, furnace	15/6
Midlands, foundry	—
,, ,, furnace	14/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box		18/-
,,	28×20	,,	36/-
,,	20×10	,,	26/3
,,	18½×14	,,	18/9
C.W.	20×14	,,	15/-
,,	28×20	,,	33/6
,,	20×10	,,	21/3
,,	18½×14	,,	15/-

Terneplates 28×20 — 33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars & nailrods, rolled, basis	£15 15 0 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars & rods, dead soft, steel	£10 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Feb. 7	..	78	5	0	dec.	37/6
,, 8	..	78	2	6	,,	2/6
,, 11	..	77	0	0	,,	22/6
,, 12	..	76	8	9	,,	11 3
,, 13	..	76	7	6	,,	1/3

Electrolytic Copper.

		£	s.	d.		
Feb. 7	..	83	0	0	inc.	25/-
,, 8	..	84	0	0	,,	20/-
,, 11	..	84	0	0	No change	
,, 12	..	83	10	0	dec.	10/-
,, 13	..	83	10	0	No change	

Standard Tin (cash).

		£	s.	d.		
Feb. 7	..	225	10	0	dec.	80/0
,, 8	..	224	0	0	,,	30/-
,, 11	..	224	7	6	inc.	7/6
,, 12	..	224	15	0	,,	7/6
,, 13	..	224	10	0	dec.	5/-

Tin (English ingots).

		£	s.	d.		
Feb. 7	..	225	10	6	dec.	90/-
,, 8	..	224	0	0	,,	30/-
,, 11	..	224	10	0	inc.	10/-
,, 12	..	224	15	0	,,	5/-
,, 13	..	224	15	0	No change	

Zinc Sheets (English).

		£	s.	d.		
Feb. 7	..	34	0	0	No change	
,, 8	..	34	0	0	,,	,,
,, 11	..	34	0	0	,,	,,
,, 12	..	34	0	0	,,	,,
,, 13	..	34	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Feb. 7	..	26	6	3	dec.	1/3
,, 8	..	26	6	3	No change	
,, 11	..	26	2	6	dec.	5/9
,, 12	..	26	2	6	No change	
,, 13	..	26	2	6	..	..

Lead (English).

		£	s.	d.		
Feb. 7	..	24	5	0	inc.	5/-
,, 8	..	24	10	0	,,	5/-
,, 11	..	24	15	0	,,	5/-
,, 12	..	24	15	0	No change	
,, 13	..	24	10	0	dec.	5/-

AVERAGE MONTHLY PRICES OF MARKED BARS (SOUTH STAFFS).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898 ...	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	8 0 0	8 0 0	7 11 8
1899 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	9 0 0	9 0 0	9 10 0	10 0 0	10 0 0	10 0 0	8 3 4
1900 ...	11 0 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 10
1901 ...	9 10 0	9 10 0	9 10 0	9 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 16 8
1902 ...	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 7 6
1903 ...	8 5 0	8 5 0	8 5 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 8 9
1904 ...	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 10
1905 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	8 1 8
1906 ...	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 10 0	8 10 0	8 10 0	9 0 0	8 15 10
1907 ...	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0
1908 ...	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 5 10
1909 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1910 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1911 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1912 ...	8 10 0	8 10 0	8 10 0	8 15 0	9 0 0	9 0 0	9 0 0	9 0 0	9 10 0	9 10 0	9 10 0	9 15 0	9 1 6
1913 ...	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	9 10 0	9 10 0	9 4 0	9 0 0	9 0 0	9 13 8
1914 ...	8 12 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 14 4
1915 ...	9 0 0	9 0 0	9 3 0	10 2 0	10 15 0	11 10 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	13 10 0	11 5 0
1916 ...	13 10 0	13 10 0	14 13 0	15 0 0	15 0 0	15 0 0	15 0 0	15 10 0	15 10 0	15 0 0	15 10 0	15 0 0	14 18 7
1917 ...	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0
1918 ...	15 12 6	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	17 0 0	17 0 0	17 0 0	16 6 3
1919 ...	18 0 0	18 10 0	20 0 0	20 0 0	23 0 0	23 0 0	23 0 0	24 12 0	25 0 0	25 0 0	25 0 0	25 5 0	22 10 7
1920 ...	26 17 6	27 0 0	28 0 0	30 5 0	30 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	31 10 2
1921 ...	31 10 0	30 3 4	27 10 0	27 10 0	27 10 0	24 15 0	21 0 0	20 0 0	20 0 0	17 10 0	17 0 0	16 0 0	23 7 4
1922 ...	16 0 0	14 17 6	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 18 1½
1923 ...	13 10 0	13 10 0	13 16 0	14 7 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 5 3½
1924 ...	14 10 0	14 10 0	14 10 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 17 6	14 17 3½
1925 ...	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 0 0	14 13 4
1926 ...	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	—*	14 10 0	14 0 10
1927 ...	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 0 0	13 0 0	12 18 0	13 15 8
1928 ...	12 10 0	12 10 0	12 10 0	12 2 6	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 2 8½
1929 ...	12 0 0	—	—	—	—	—	—	—	—	—	—	—	—

* No quotation available.

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(A remittance should accompany instructions.)

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PRACTICAL FOUNDRYMAN desires position as Foreman; accustomed to Iron or Non-ferrous Repetition, Machine Moulding and General Jobbing.—Box 998, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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MACHINERY.—*Continued.*

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CUPOLAS.—One 6-ton capacity, about 40 ft. high, 6 ft. dia., complete; one 4-ton capacity, 38 ft. high, 5 ft. dia., complete.—For further particulars, write Box 108, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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